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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A climatology of extinction coefficients for the 3-5 and 8-12 micrometer bands is presented for the North Atlantic Ocean region. Isopleths of mean extinction coefficients are provided for each month. Contours of the standard deviation of the extinction coefficients are given for the months of January and July. The magnitude of the standard deviation frequently exceeds the mean value, and indicates the extreme variability of infrared extinction in this region.

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AB (27) A climatology of extinction coefficients for the 3-5 and 8-12 micrometer bands is presented for the North Atlantic Ocean region. Isopleths of mean extinction coefficients are provided for each month. Contours of the standard deviation of the extinction coefficients are given for the months of January and July. The magnitude of the standard deviation frequently exceeds the mean value, and indicates the extreme variability of infrared extinction in this region. (Author)
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CLIMATOLOGY OF SURFACE INFRARED EXTINCTION COEFFICIENTS IN THE NORTH ATLANTIC OCEAN REGION

Terry Brown and Andreas K. Goroch
Naval Environmental Prediction Research Facility

AUGUST 1982

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MONTEREY, CALIFORNIA 93940

CONTENTS

1. Introduction

The performance of infrared sensors which detect radiation in either the 3-5 or the 8-12 micrometer band is degraded primarily by molecular water vapor absorption and secondarily by aerosol absorption. The combination of these effects can be expressed by the extinction coefficient.

This climatology presents mean extinction coefficients for the North Atlantic Ocean. The standard deviation of the extinction coefficient is included. The coefficients are calculated from surface observations of meteorological parameters and are categorized diurnally and monthly.

2. Method

Observations made aboard transient ships between 1963 and 1973 were analyzed using an algorithm which evaluates molecular and aerosol absorption separately. The effect of precipitation and fog was also evaluated. Total extinction is the sum of the individual extinction coefficients. The method assumes horizontal homogeneity.

2.1 Molecular Extinction

The primary molecular absorber in the infrared bands is water vapor. The extinction model uses a polynomial fit to the correlations between absolute humidity and transmittance developed for LOWTRAN 3B. In converting from transmittance to extinction, a 10 kilometer range was used to approximate the range dependence of the extinction coefficient. The model

incorporates the effect of other atmospheric gases, including nitrogen, methane and ozone. The LOWTRAN 3B model is described by Selby et al. (1976).

2.2 Aerosol Extinction

Two classes of aerosols comprise the marine aerosol burden: a coarse mode generally consisting of sea salt particles produced by wave action; and an accumulation mode consisting of smaller particles which are usually generated over land and transported over the ocean. The size of these aerosols is proportional to the ambient relative humidity with larger equilibrium radii occurring at higher humidities. The total aerosol extinction depends on the aerosol concentration and size distribution.

Aerosol extinction was related to the aerosol distribution by modeling Mie extinction. Size-dependent extinction factors were calculated for each particle size using an approximation of the Mie series. The extinction factors were integrated using Simpson's rule.

Correlations of aerosol extinction with wind speed and relative humidity were fit to the product of two six-term polynomials derived from the aerosol model of Ruhnke and Katz (Katz, 1979). The polynomials are shown in Table 1.

2.3 Extinction by Precipitation and Fog

This climatology assumes the infrared range to equal the visible range when the latter is less than 1 kilometer (Chu and Hogg, 1968). For rainy conditions, the infrared extinction was calculated using the approximate Mie extinction mentioned in

Table 1. Polynomials for aerosol extinction.
(Katz et al., 1979)

(A) Visible

V<10.5				V>10.5			
	V		RH		V		RH
a_1	8.0656290E-01	b_1	-4.0724070E+00	a_1	-8.5042480E+00	b_1	-6.1357060E+00
a_2	4.8520300E-02	b_2	3.8657170E-01	a_2	3.7821490E+00	b_2	5.8396200E-01
a_3	5.3597340E-03	b_3	-1.4057360E-02	a_3	-6.0528960E-01	b_3	-2.1248330E-02
a_4	0.	b_4	2.4963620E-04	a_4	4.8357760E-02	b_4	3.7770160E-04
a_5	0.	b_5	-2.1680100E-06	a_5	-1.9157190E-03	b_5	-3.2840400E-06
a_6	0.	b_6	7.3886720E-09	a_6	3.0789070E-05	b_6	1.1209860E-08

(B) IR (3-5 μm)

V	RH	V	RH
4.4830400E-01	-1.0954810E+00	-1.5394480E+01	-3.6260420E+00
9.4428620E-02	1.0332880E-01	6.5652260E+00	3.4324990E-01
2.9353200E-02	-3.7567660E-03	-1.0650840E+00	-1.2486140E-02
0.	6.6711950E-05	8.6452940E-02	2.2191880E-04
0.	-5.7940950E-07	-3.4728240E-03	-1.9295010E-06
0.	1.9750270E-09	5.6775010E-05	6.5872470E-09

(C) IR (8-12)

V	RH	V	RH
5.7299230E-01	-4.9008940E-01	-2.2558370E+01	-1.9854980E+00
4.0375010E-02	4.6270000E-02	9.9913630E+00	1.8723860E-01
3.3178700E-02	-1.6824490E-03	-1.7116370E+00	-6.8089500E-03
0.	2.9862250E-05	1.4629840E-01	1.2091620E-04
0.	-2.5918130E-07	-6.2036010E-03	-1.0501340E-06
0.	8.8256150E-10	1.0738750E-04	3.5788830E-09

$$\beta = [a_1+u(a_2+V(a_3+V(a_4+V(a_5+Va_6))))]\,[b_1+R(b_2+R(b_3+R(b_4+R(b_5+Rb_6))))]$$

where

$$V = \begin{cases} v-3.5 & v>4 \text{ m/s} \\ 0.5 & v<4 \text{ m/s} \end{cases}$$

$R = RH$

β = aerosol extinction (1/km)

Para. 2.2 and a Marshall-Palmer raindrop size distribution. The extinction was related to the present weather indicator as shown in Table 2. Extinction due to snow or ice was not calculated.

Table 2. Infrared extinction coefficient as related to present weather indicator.

Present Weather Indicator	Description	Extinction Coefficient (Km^{-1})
50-59	Drizzle	0.035
60	Slight, intermittent rain	
61	Slight, continuous rain	0.2
80	Slight rain shower	
62	Moderate, intermittent rain	
63	Moderate. continuous rain	0.6
81	Moderate or heavy rain shower	
64	Heavy, intermittent rain	
65	Heavy, continuous rain	1.6
82	Violent rain shower	

3. Results

Isopleths of monthly mean extinction coefficient values are shown for each infrared band in Figures 1-72; data are presented for day, night and combined periods. Contours of the standard deviation of the extinction coefficient are shown in Figures 73-84.

Standard deviation statistics are shown only for January and July since the data were too variable for computer contouring. Therefore, subjective analysis of the standard deviation fields was done by hand. The magnitude of the standard deviation is generally larger than the mean value and indicates the extreme variability of infrared extinction over the North Atlantic Ocean. This variability is greatest between $40^{o}N$ and $60^{o}N$.

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Chu, T. S., and D. C. Hogg, 1968: Effects of precipitation on propagation on propagation at 0.63, 3.5 and 10.6 microns. Bell Sys. Tech. J., 47, N5, 723-759.

Katz, B. K., 1979: Personal communication.

Selby, J. E.A., E. P. Shettle, and R. A. McClatchey, 1976: Atmospheric transmittance from 0.25 to 28.5 μm: supplement LOWTRAN 3B, AFGL-TR-76-0258, ADA 040701.

FIGURES

Figures 1-84 are sequenced for the 12 months of the calendar year Jan-Dec, as follows:

Mean Extinction Coefficients, 3-5 Microns

All Hours -- Figs. 1-12 (day and night combined)
Nighttime -- Figs. 13-24
Daytime -- Figs. 25-36

Mean Extinction Coefficients, 8-12 Microns

All Hours -- Figs. 37-48 (day and night combined)
Nighttime -- Figs. 49-60
Daytime -- Figs. 61-72

Extinction Coefficient Standard Deviation, 3-5 Microns*

All Hours -- Figs. 73, 74 (day and night combined)
Nighttime -- Figs. 75, 76
Daytime -- Figs. 77, 78

Extinction Coefficient Standard Deviation, 8-12 Microns*

All Hours -- Figs. 79, 80 (day and night combined)
Nighttime -- Figs. 81, 82
Daytime -- Figs. 83, 84

*Months of January and July only.

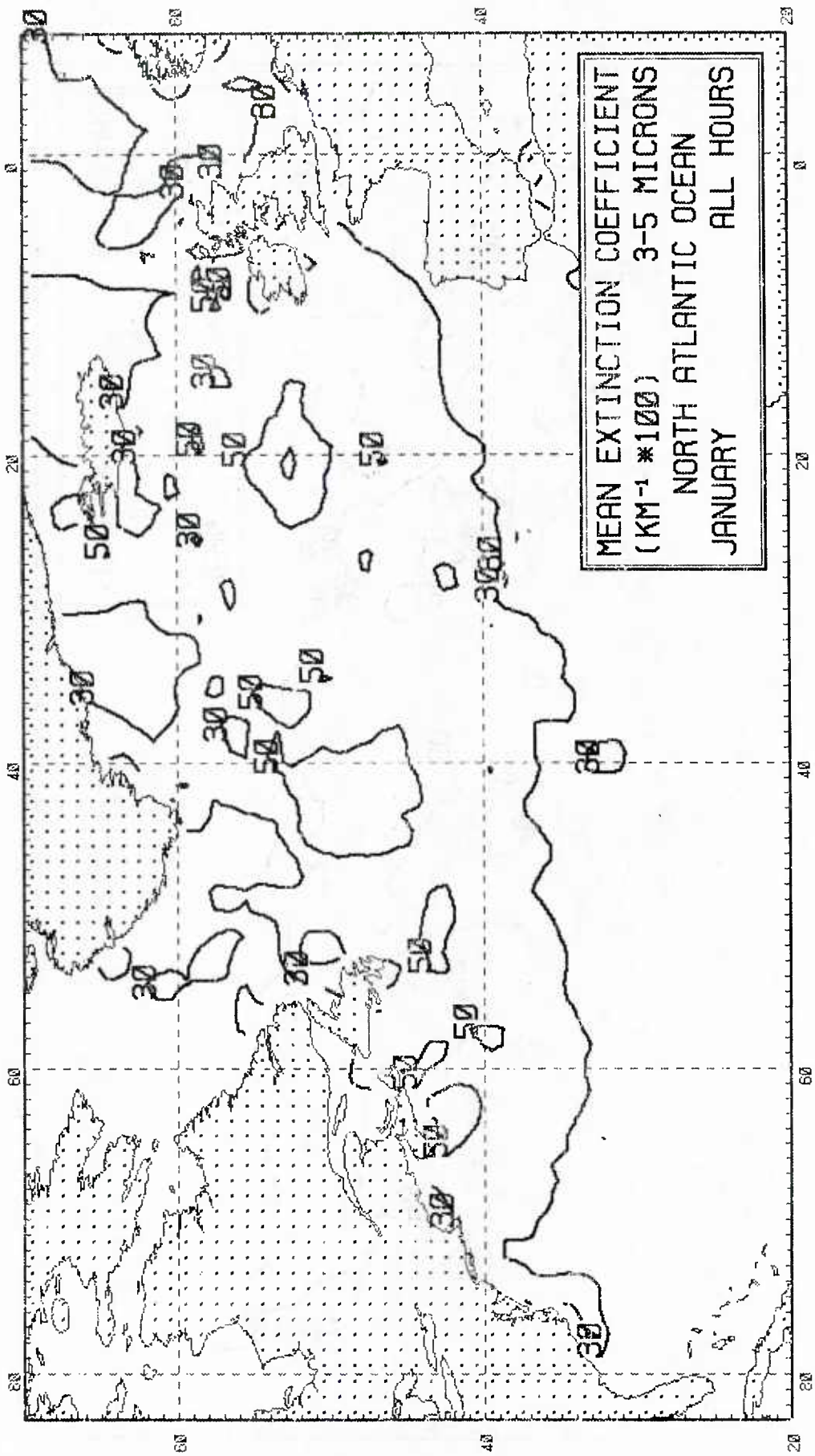

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JANUARY ALL HOURS

FIGURE 1

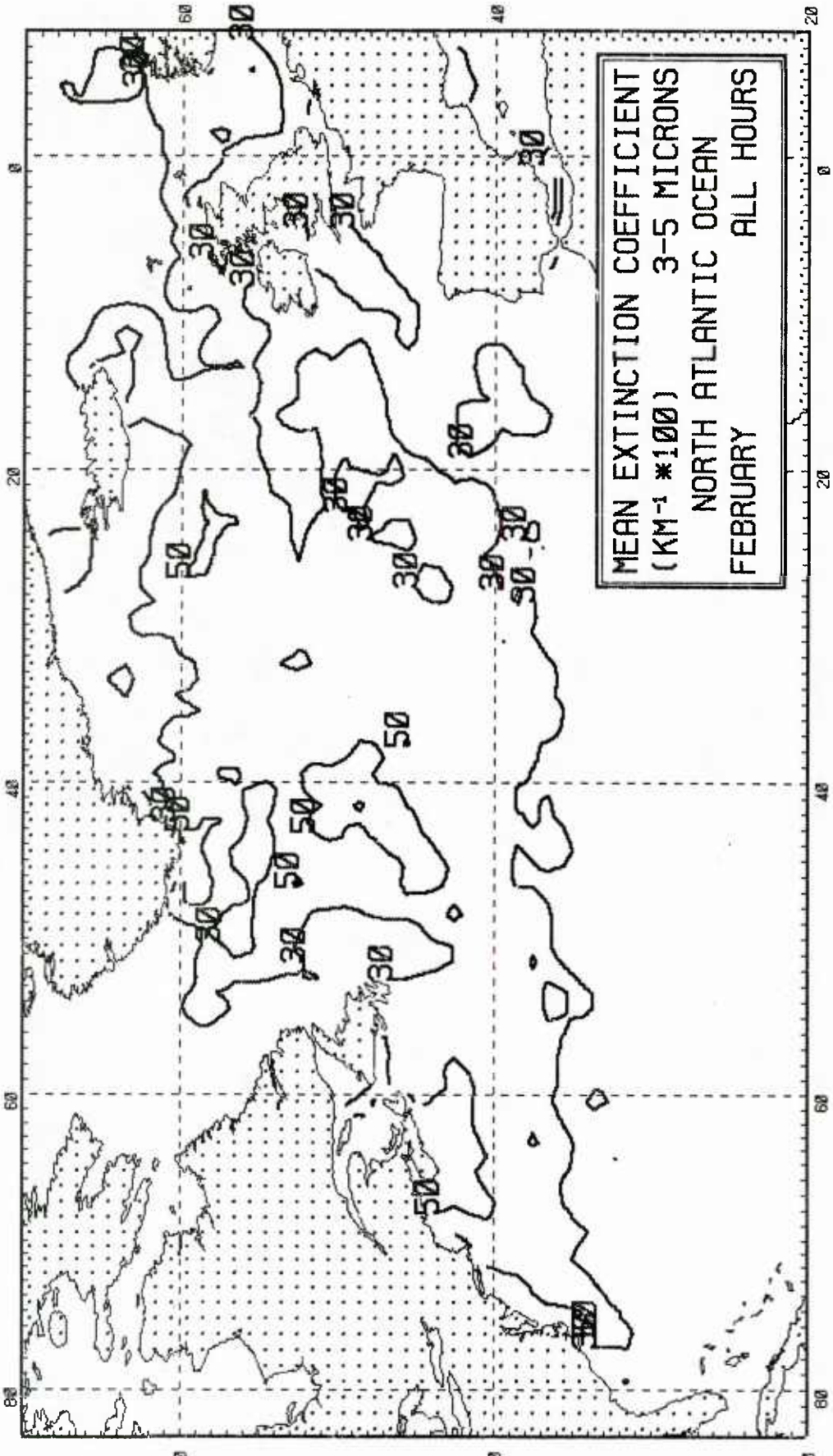

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
FEBRUARY ALL HOURS

FIGURE 2

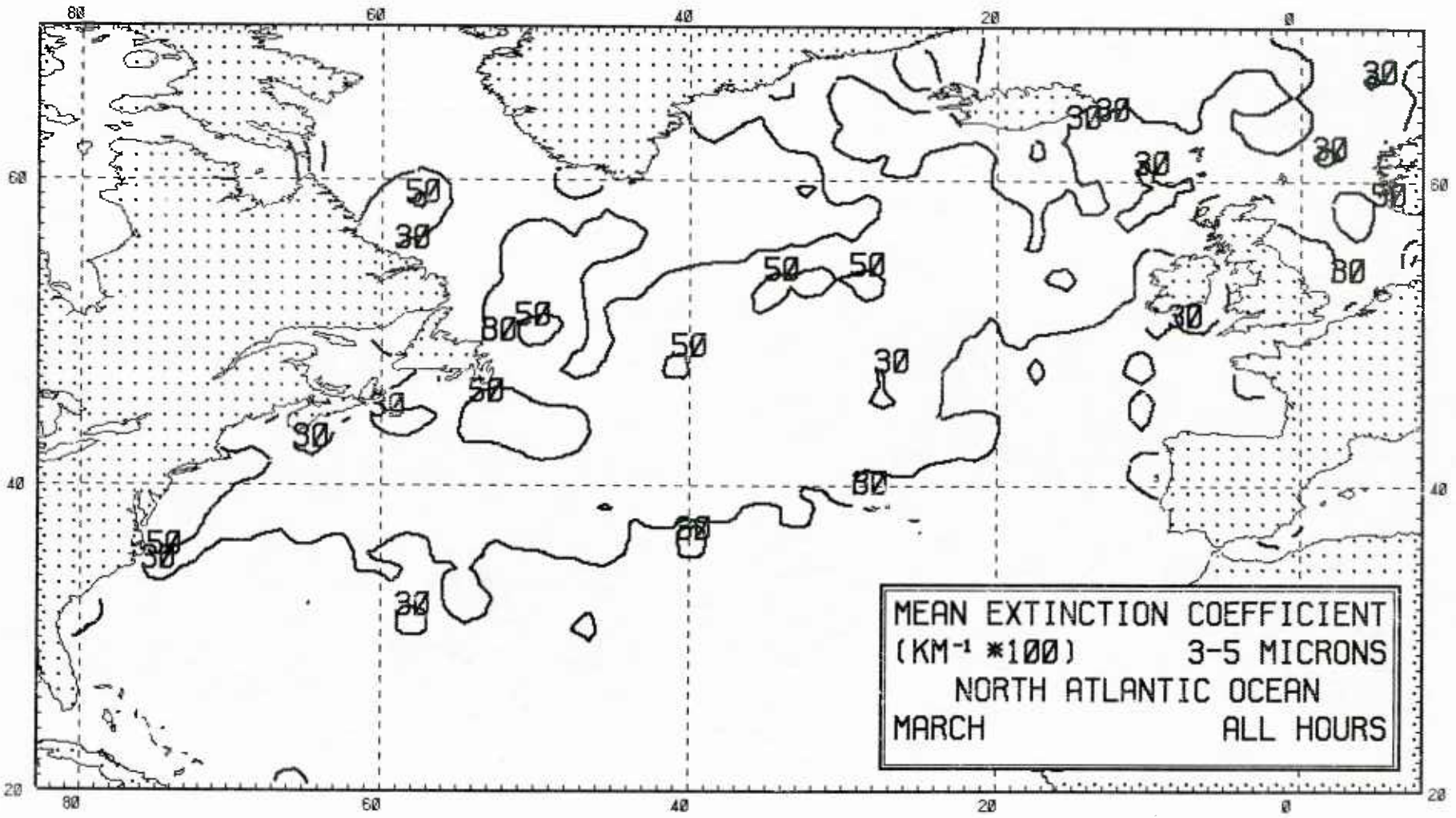

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
MARCH ALL HOURS

FIGURE 3

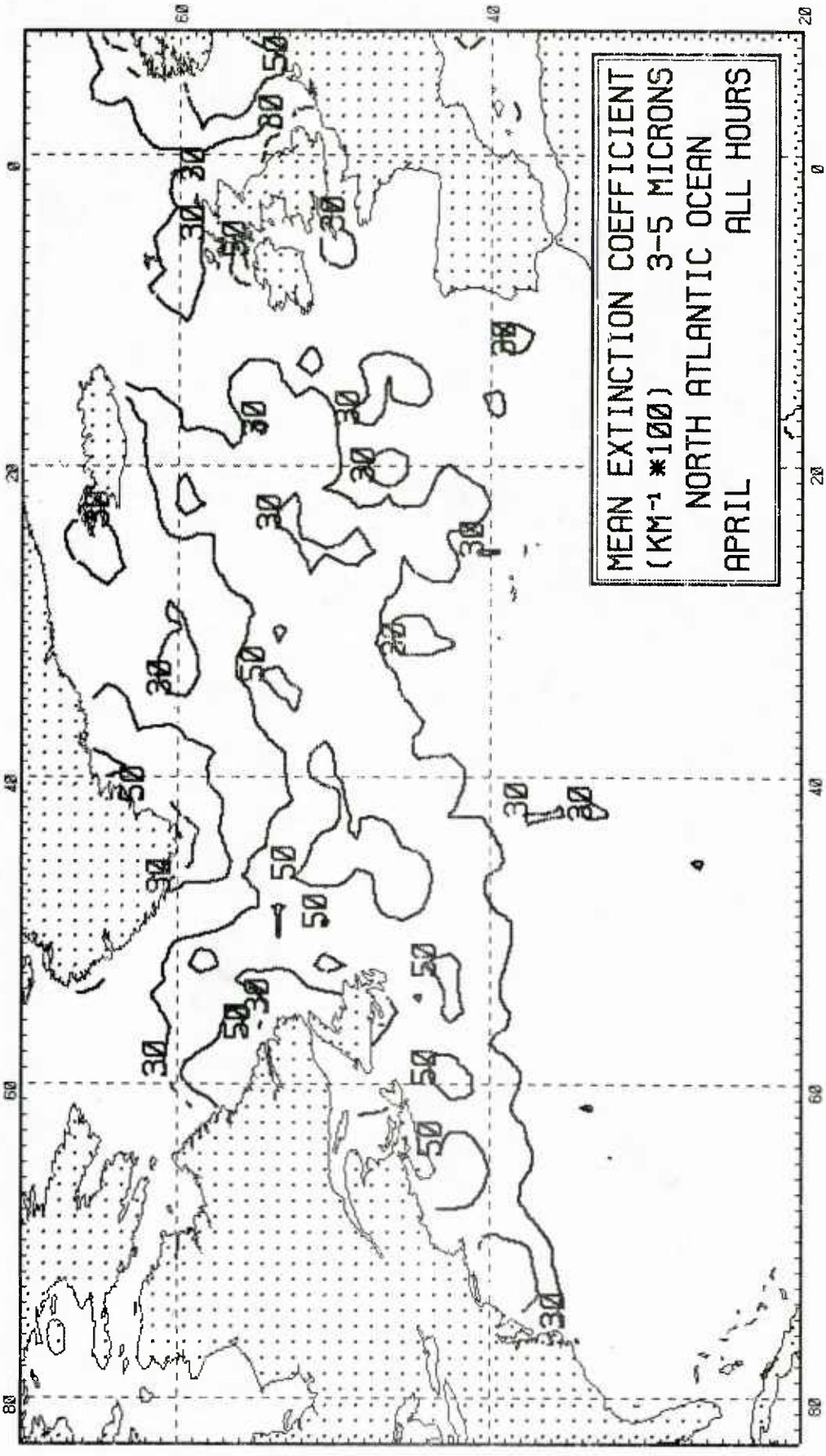

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
APRIL ALL HOURS

FIGURE 4

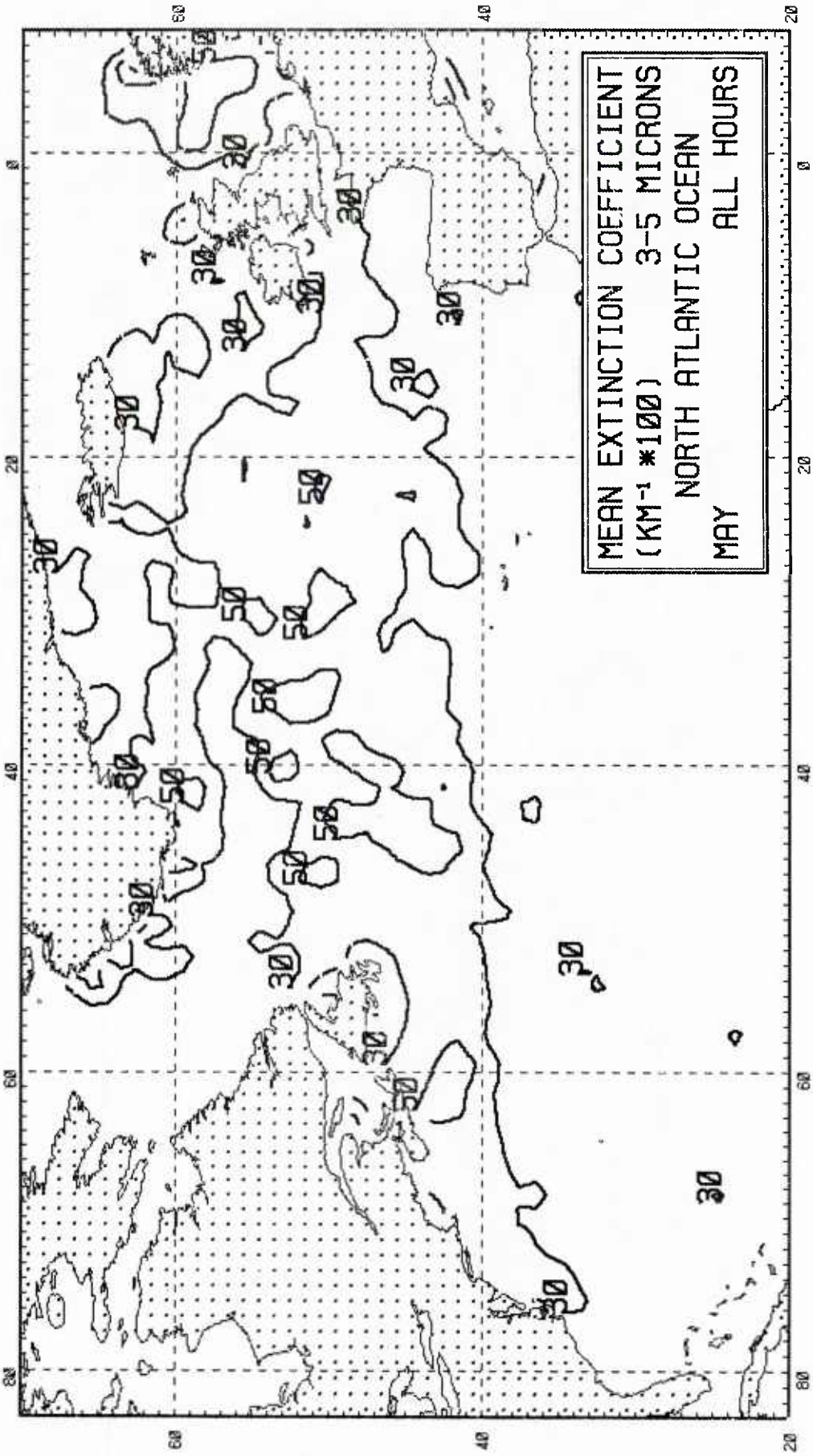

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
MAY ALL HOURS
80
60
40
20
0
20
40
60
80

FIGURE 5

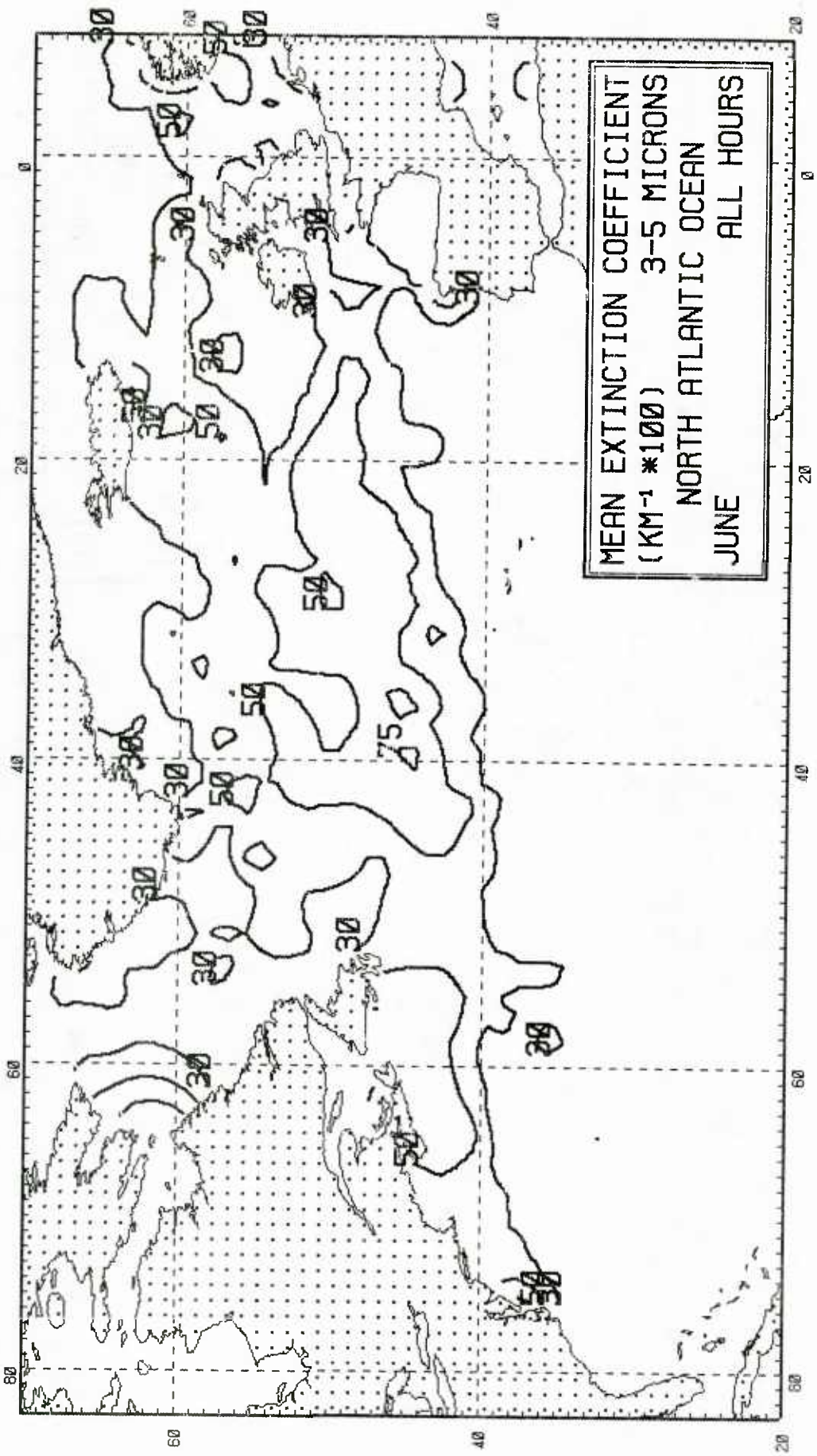

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
JUNE
ALL HOURS

FIGURE 6

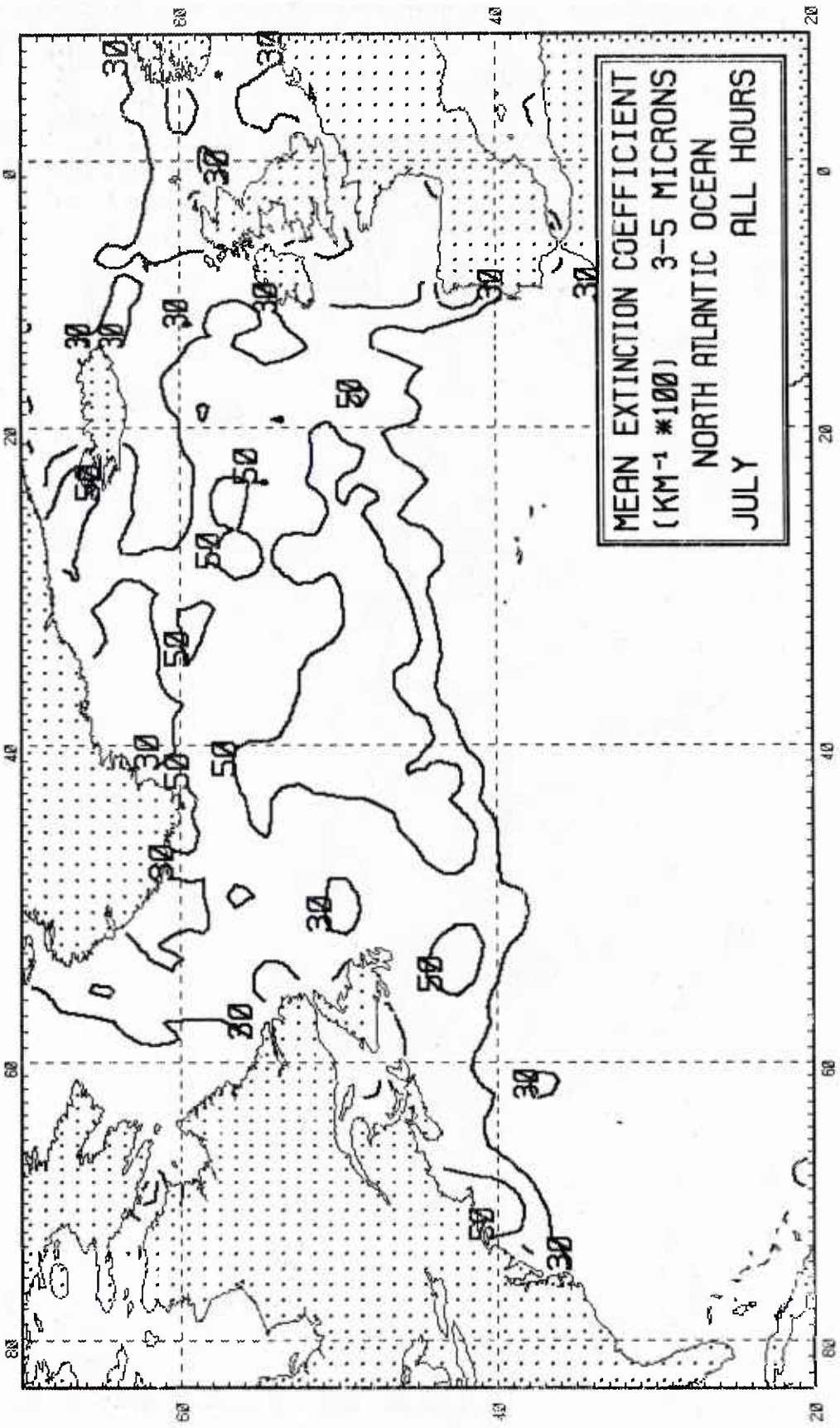

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JULY ALL HOURS
80
60
40
20
0
20
40
60
80
30
50

FIGURE 7

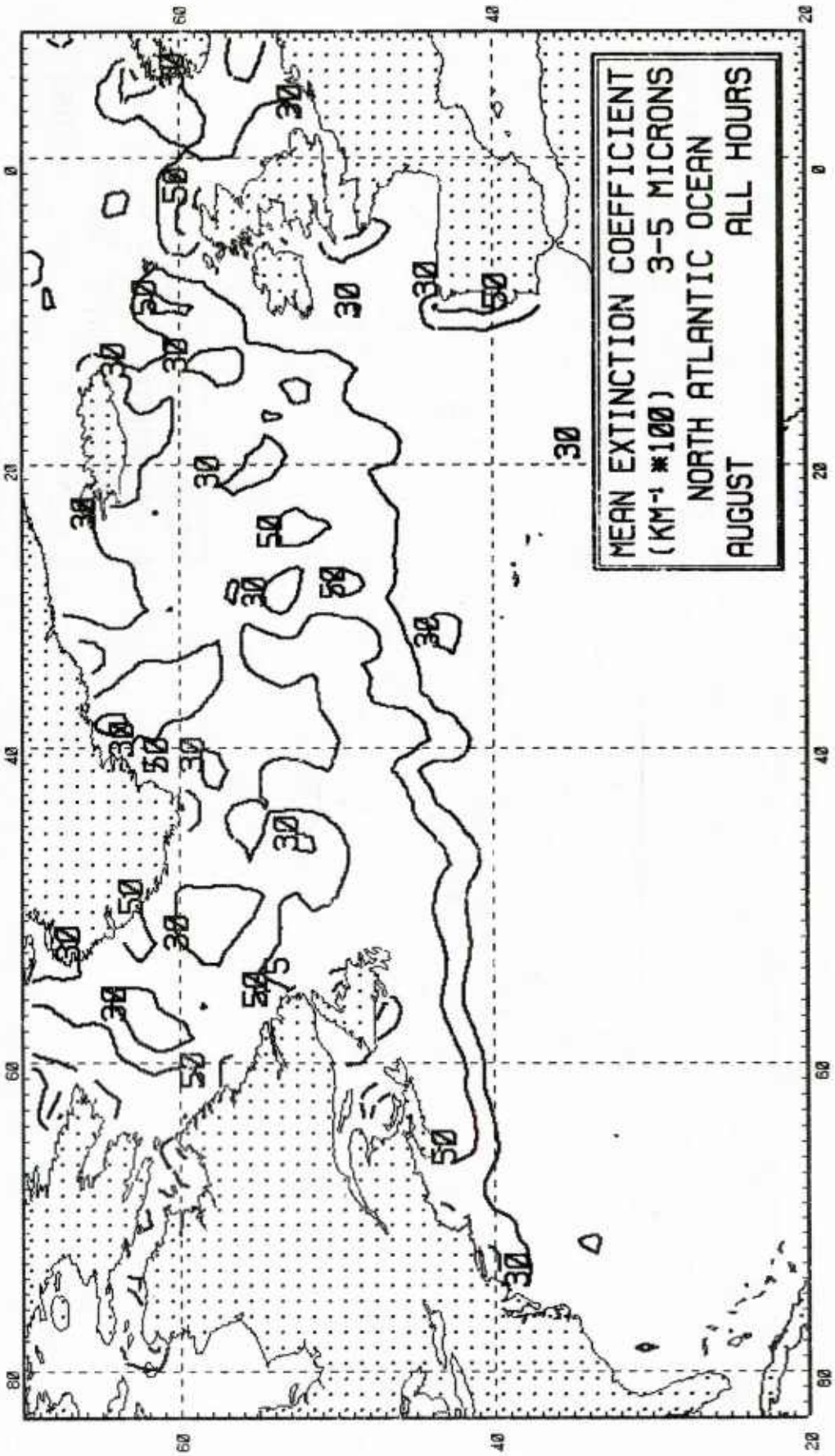

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
AUGUST
ALL HOURS
60
40
20
0
20
40
60
80
30
50

FIGURE 8

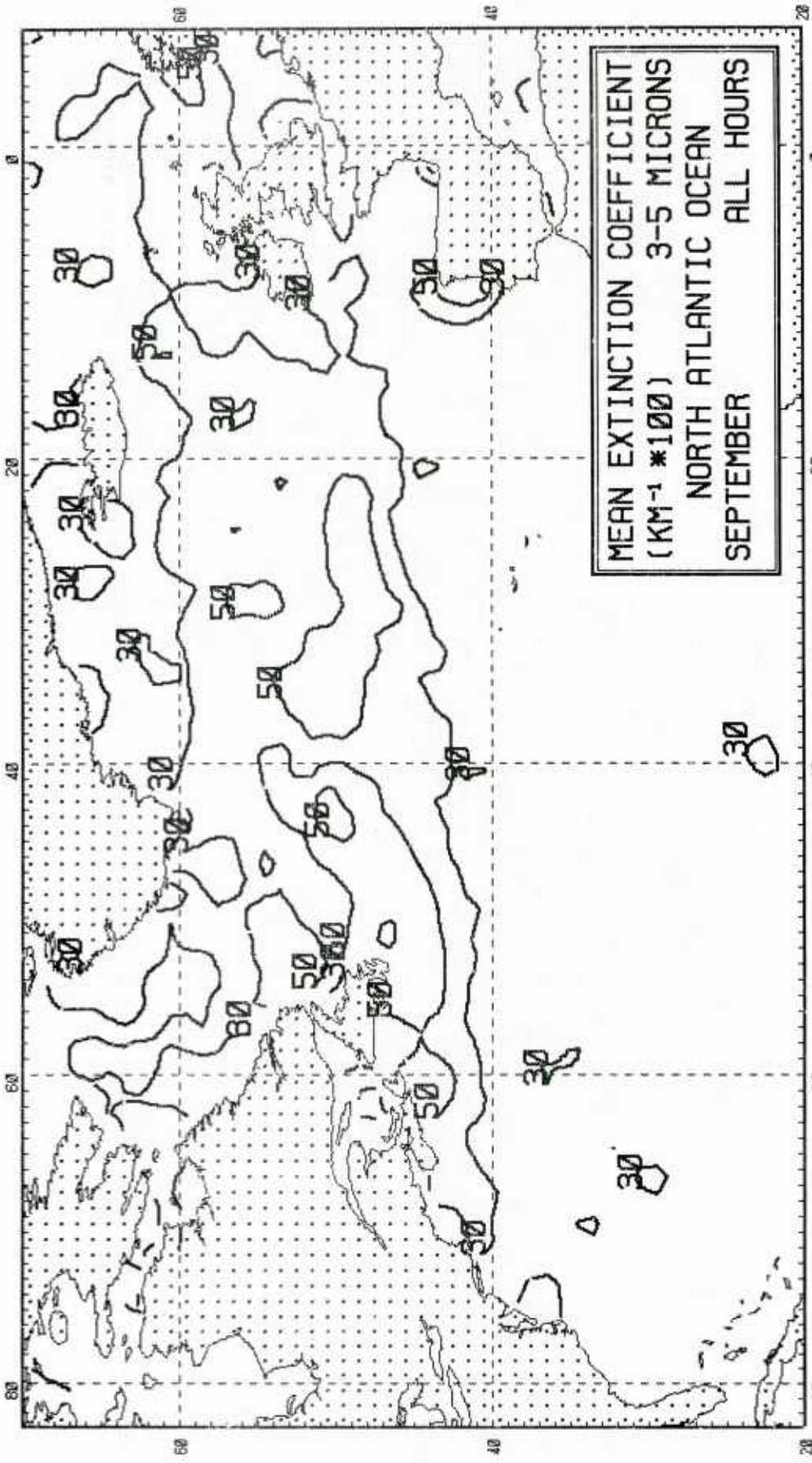
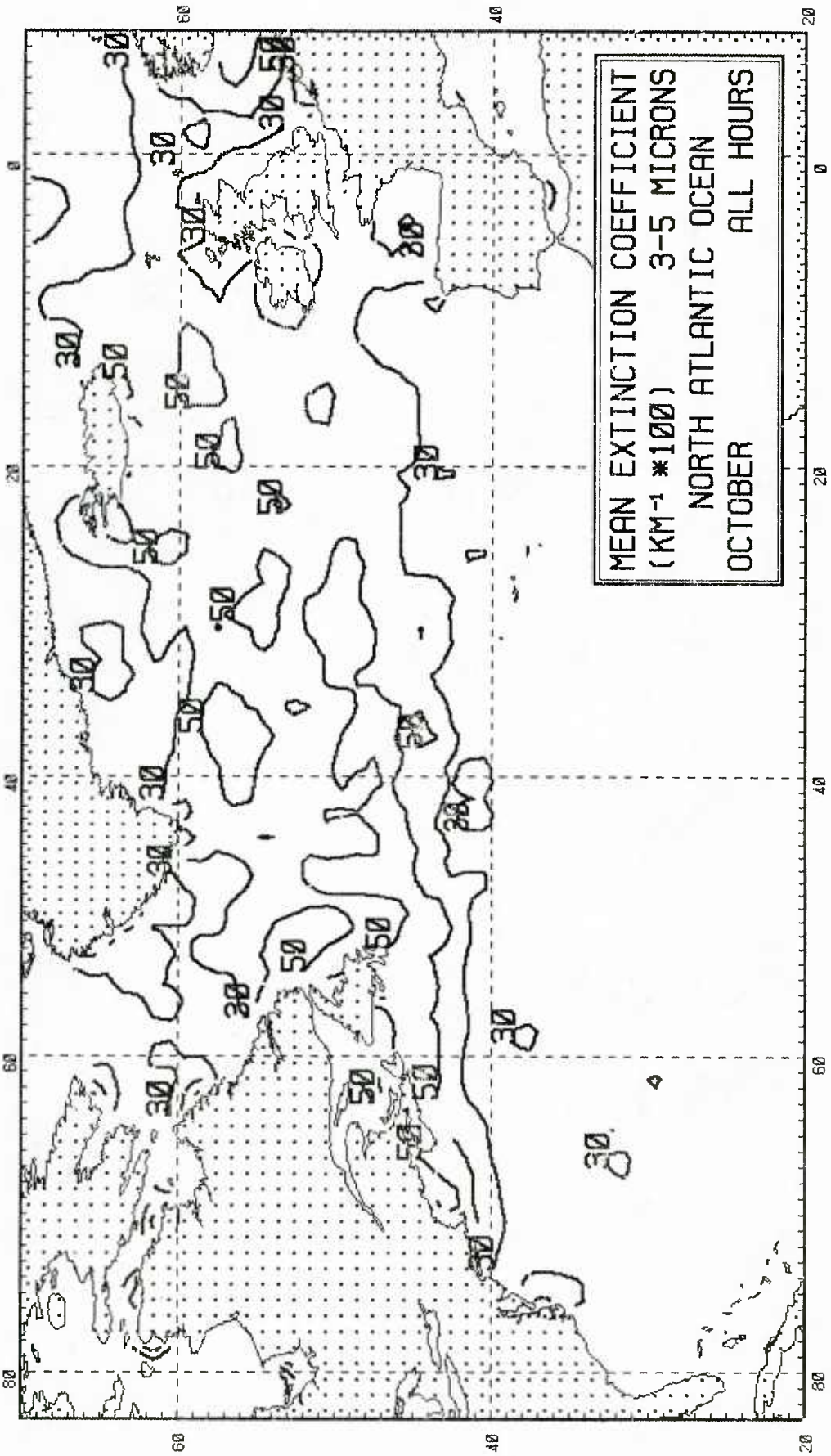

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
SEPTEMBER ALL HOURS

FIGURE 9


MEAN EXTINCTION COEFFICIENT
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3-5 MICRONS
NORTH ATLANTIC OCEAN
OCTOBER
ALL HOURS

FIGURE 10

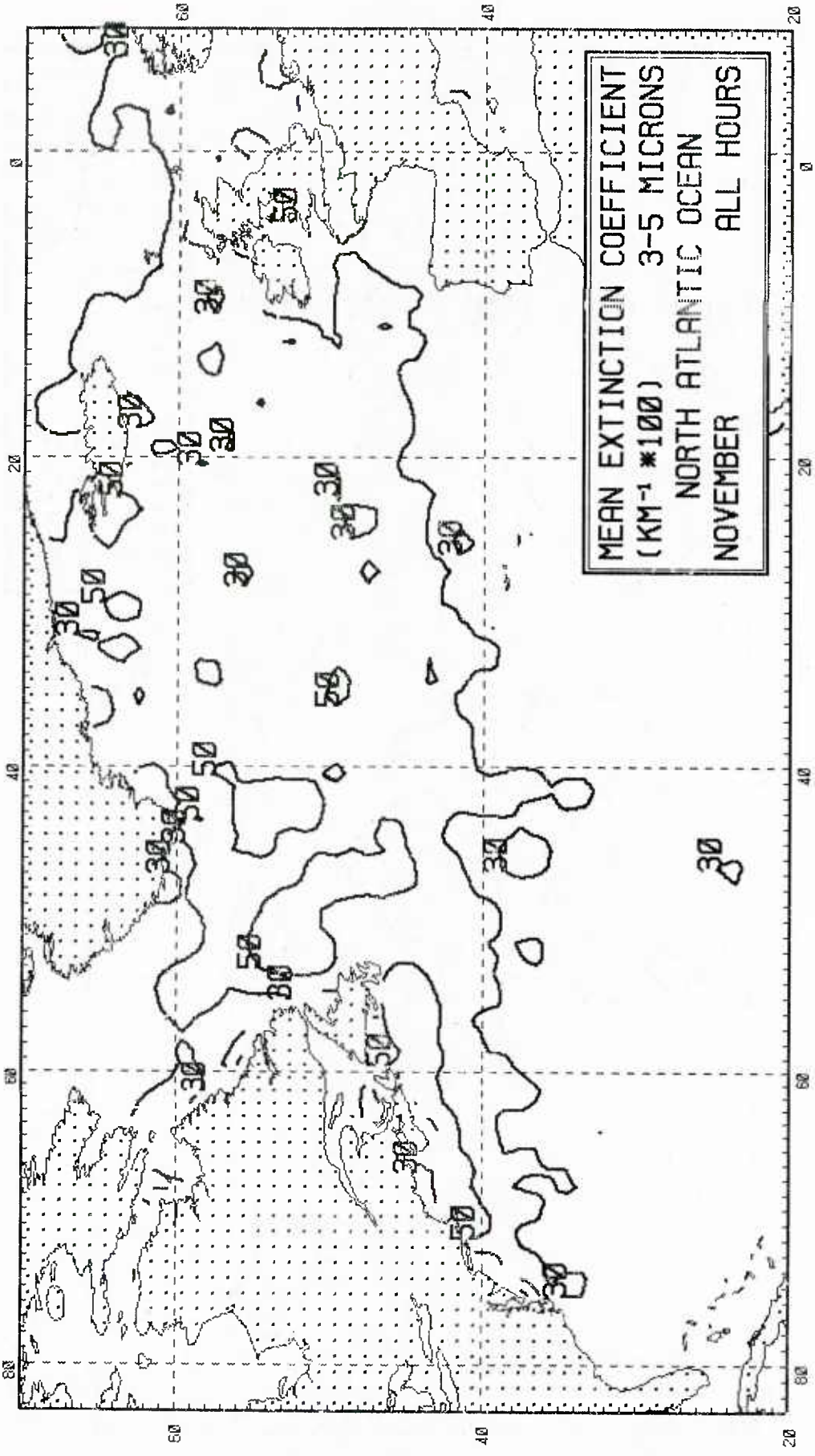

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
NOVEMBER
ALL HOURS

FIGURE 11

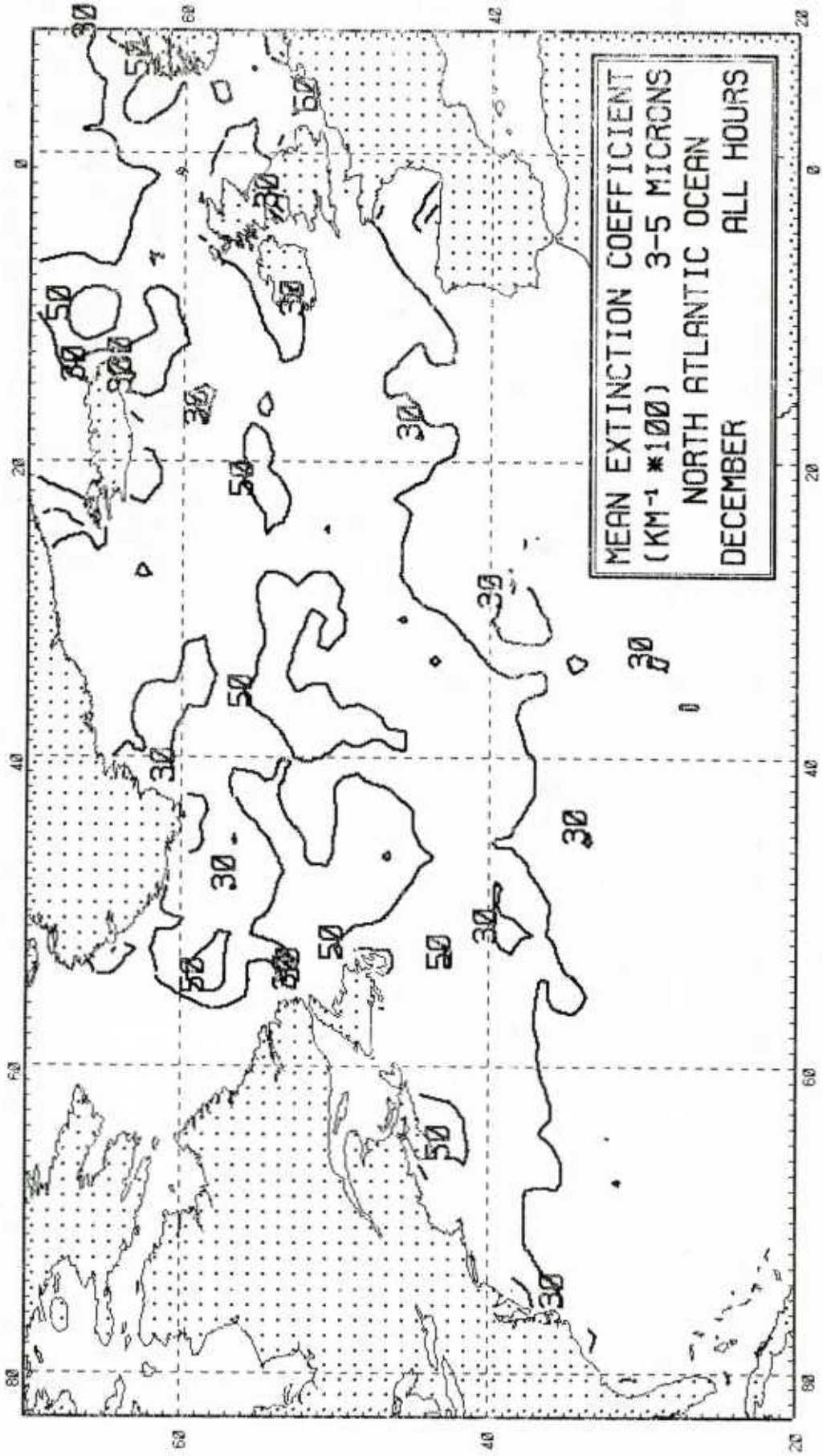

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
DECEMBER
ALL HOURS

FIGURE 12

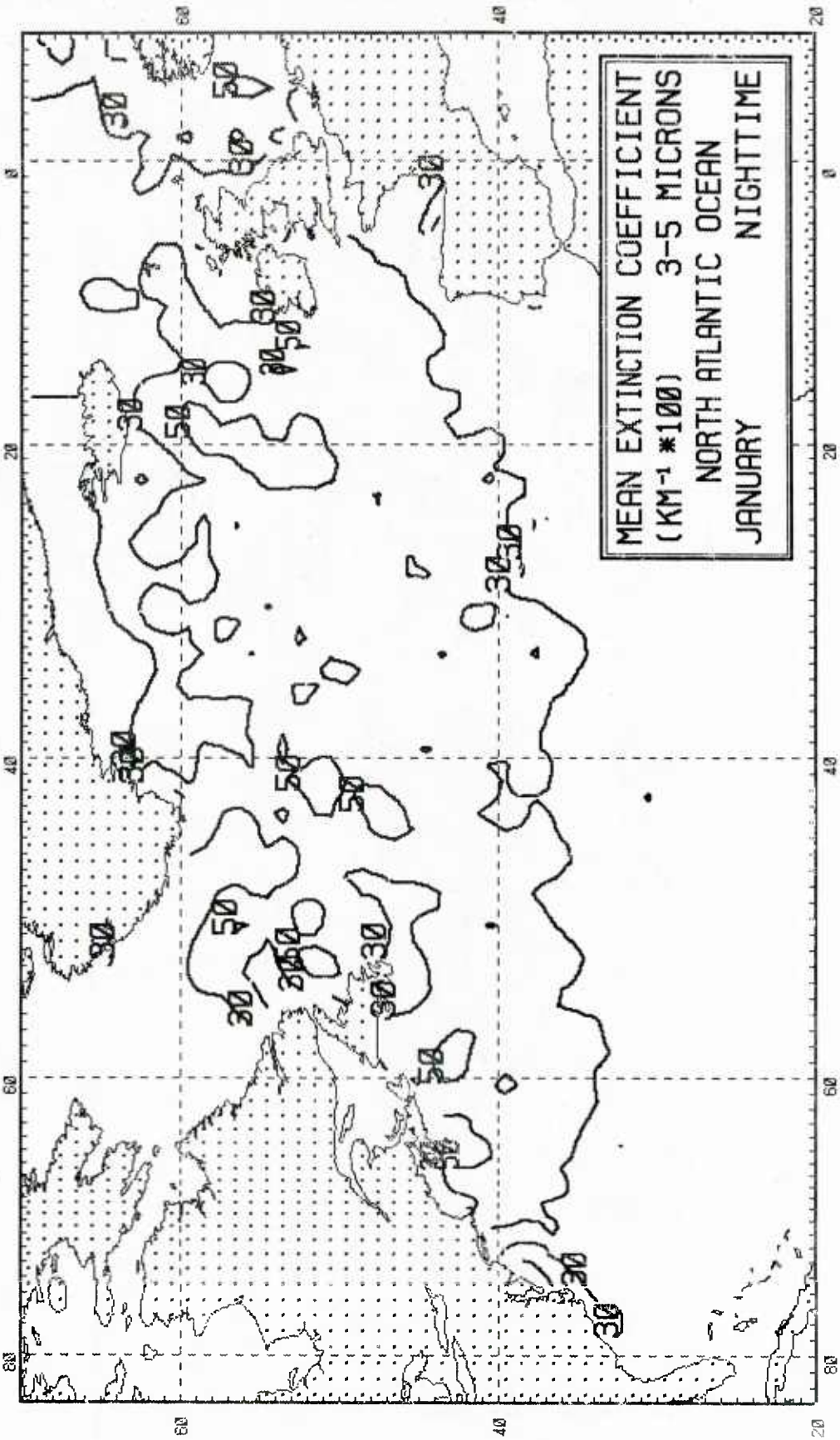
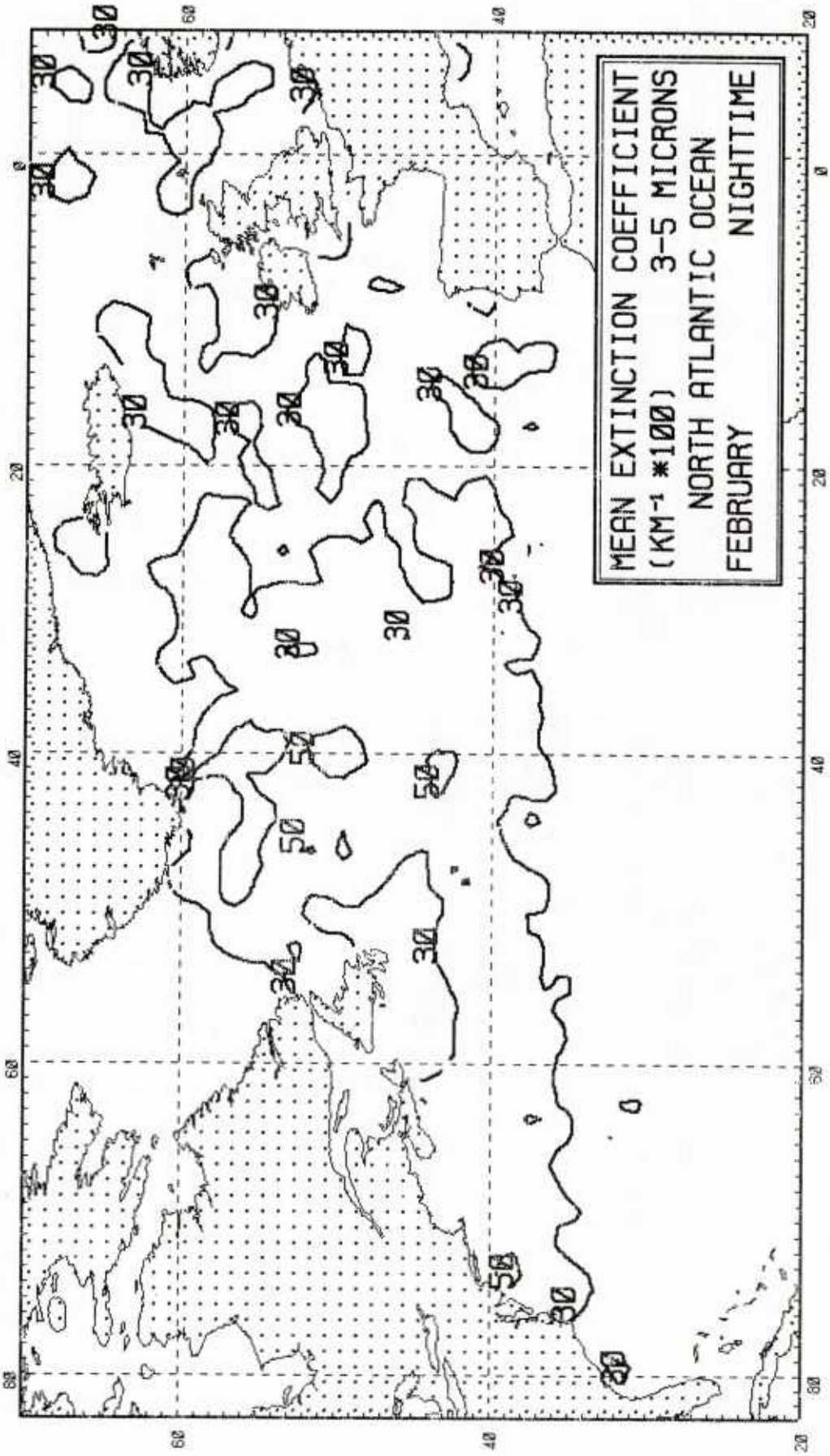

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JANUARY NIGHTTIME

FIGURE 13


MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
FEBRUARY NIGHTTIME

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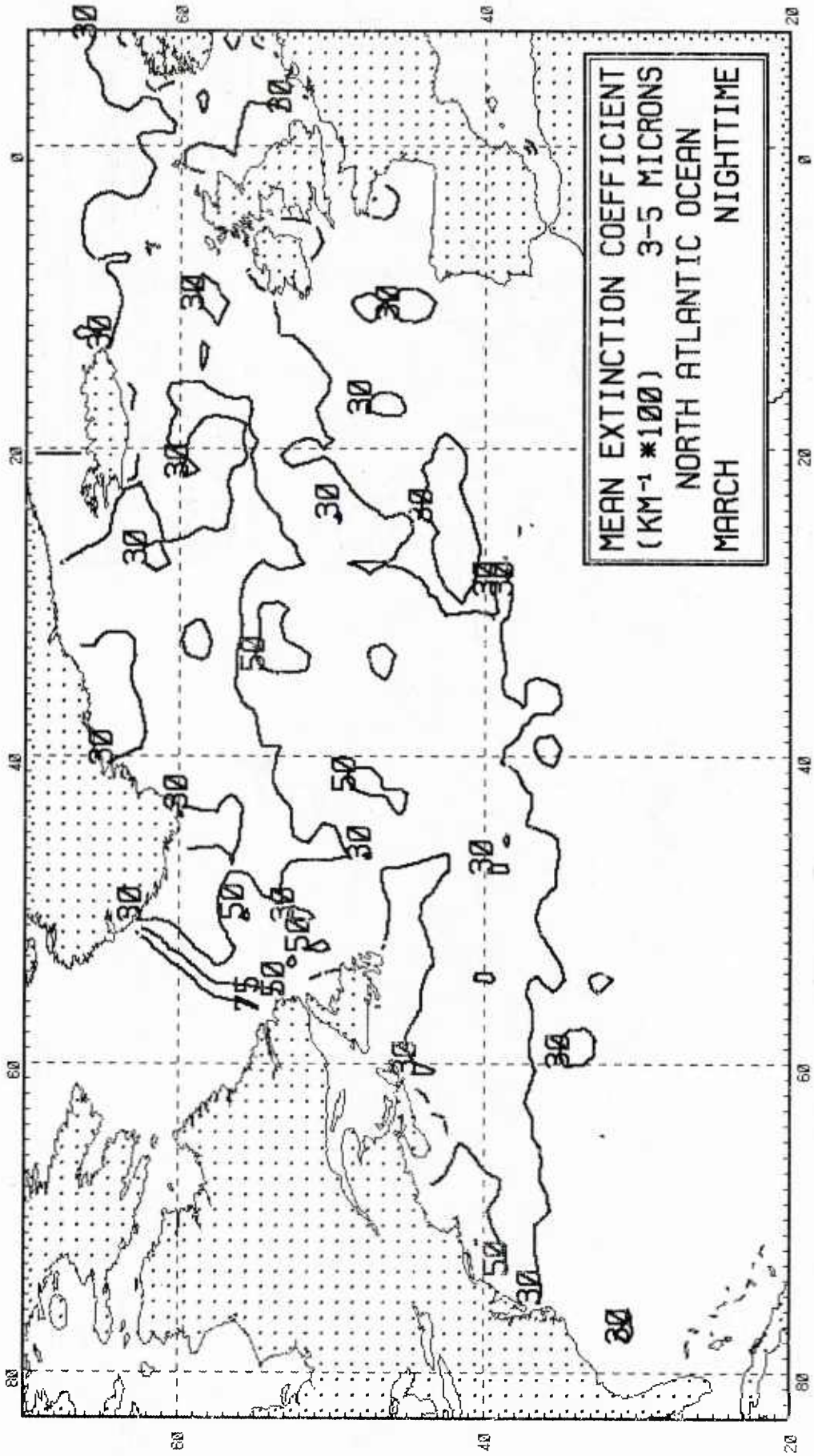
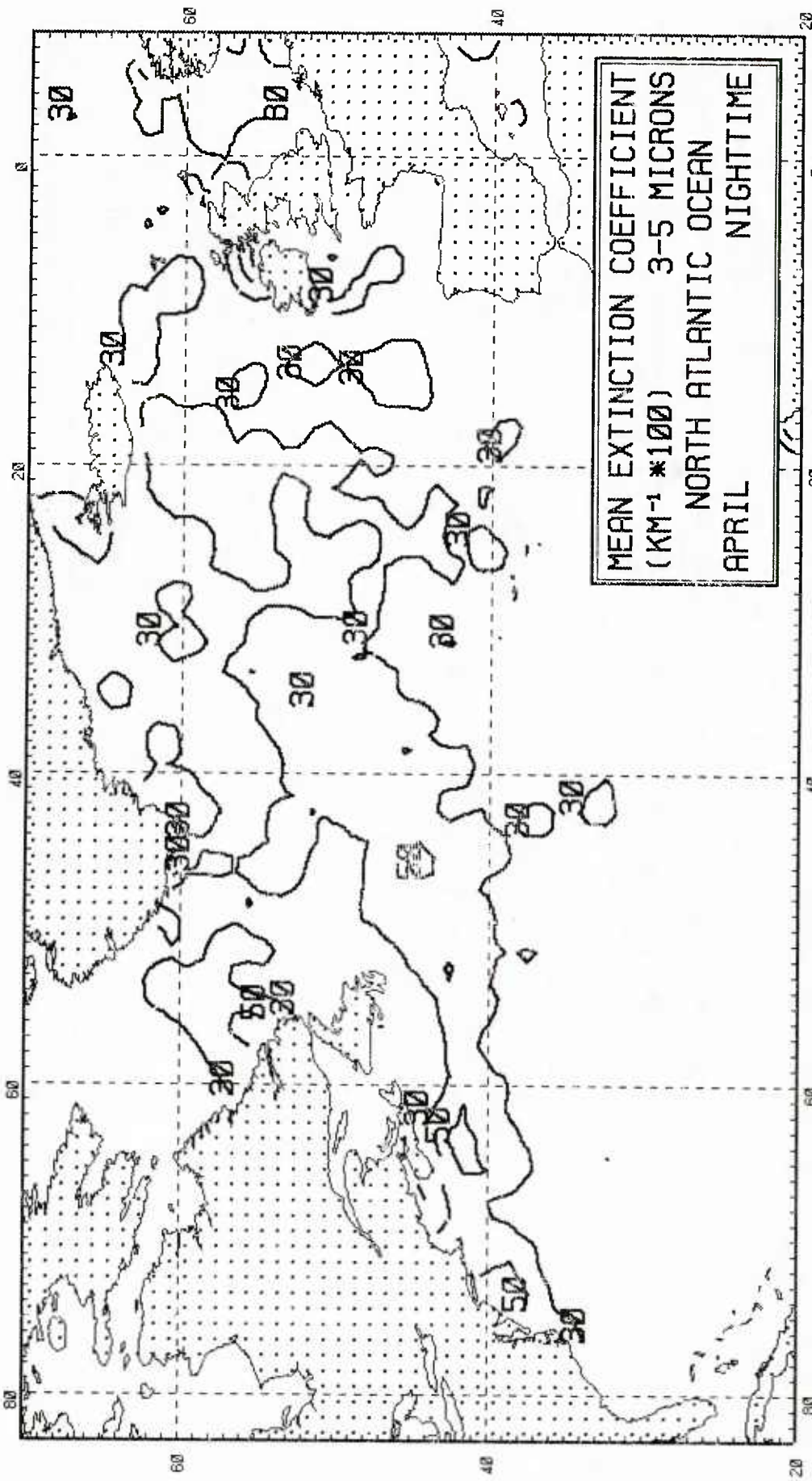

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
MARCH
NIGHTTIME

FIGURE 15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NORTH ATLANTIC OCEAN
APRIL NIGHTTIME

FIGURE 16

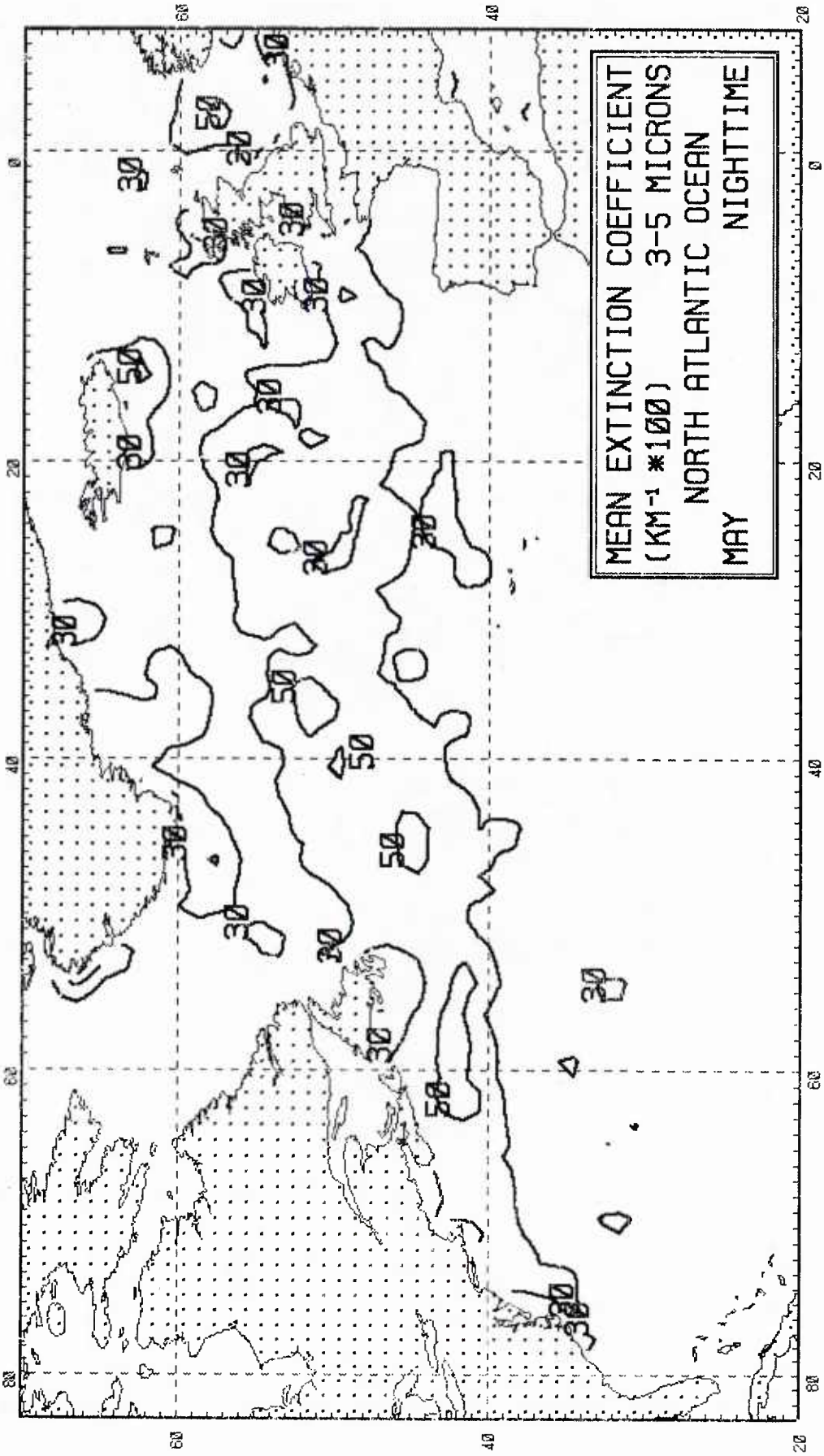

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
MAY NIGHTTIME
80
60
40
20
0
20
40
60
80
30
50

FIGURE 17

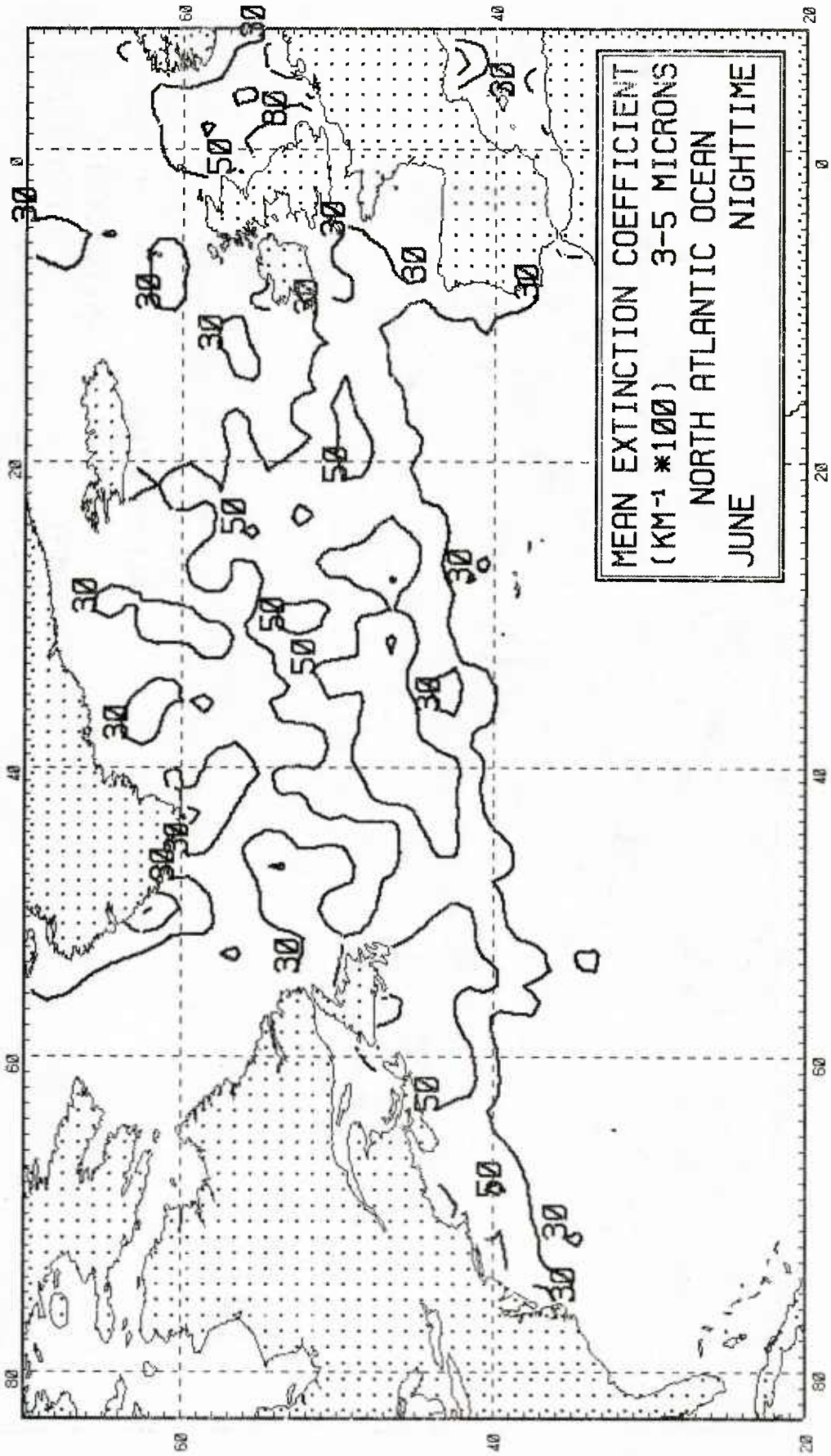
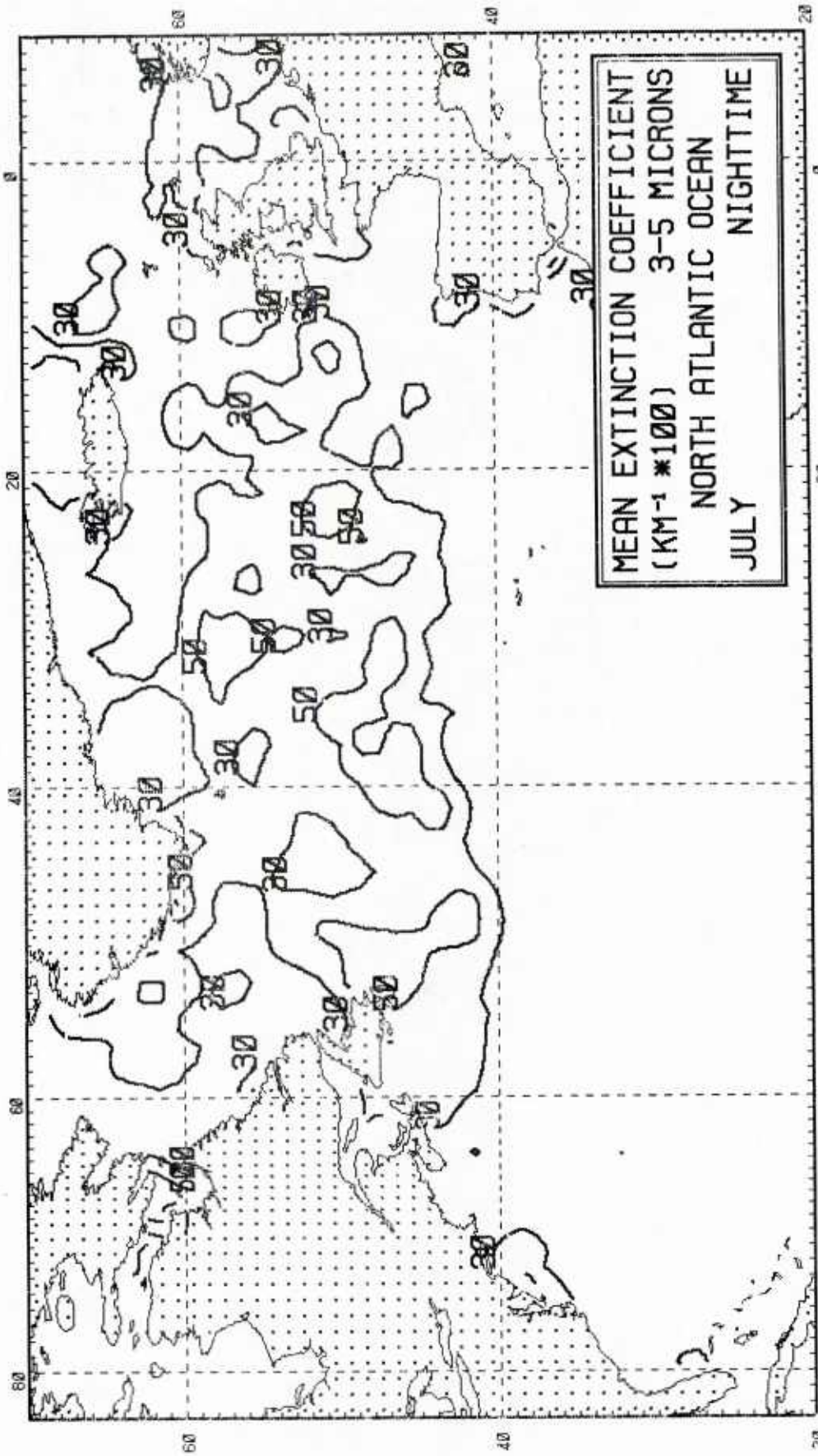

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JUNE NIGHTTIME
30
50
60
0
20
40
60
80

FIGURE 18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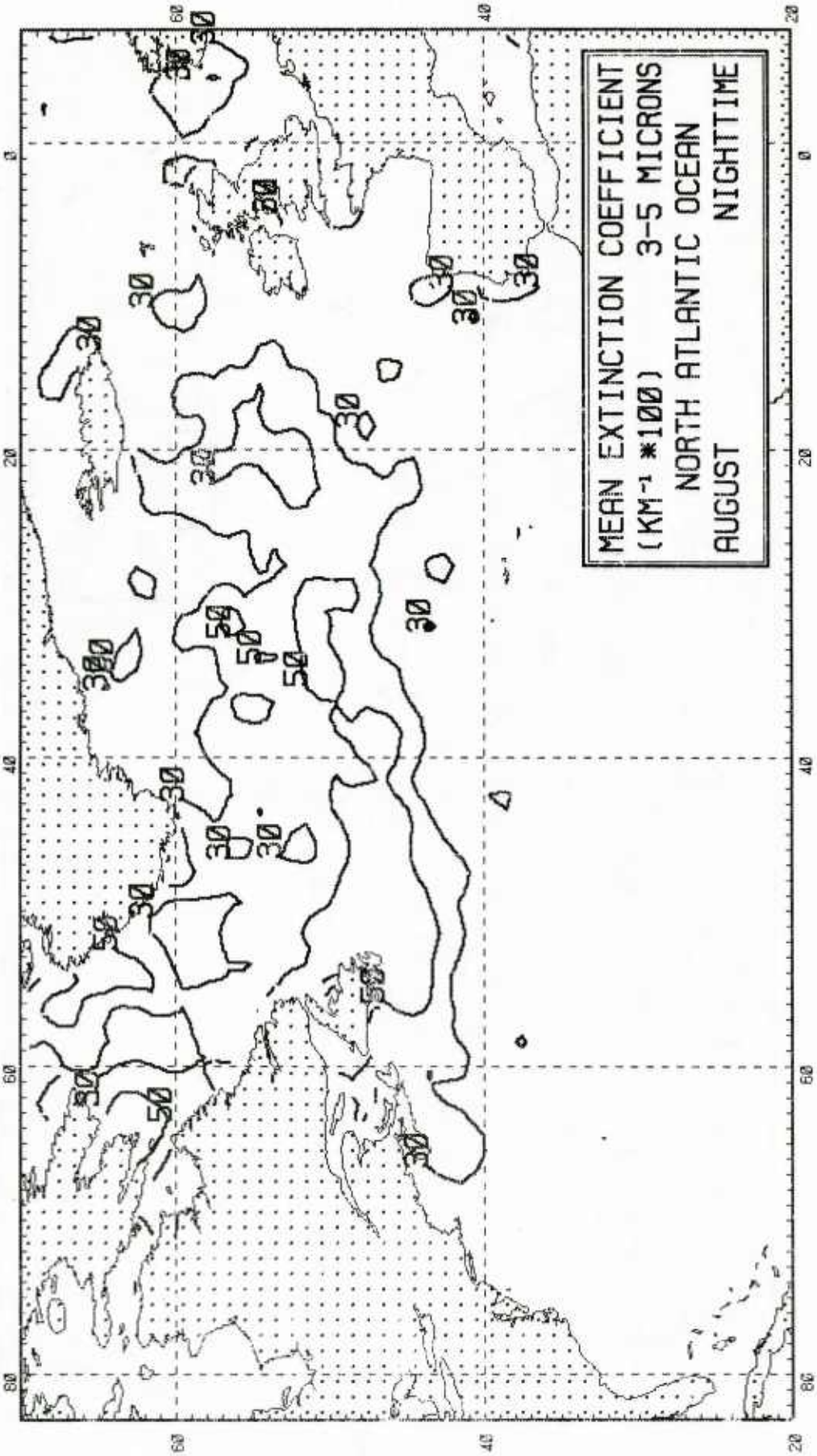
NORTH ATLANTIC OCEAN
JULY NIGHTTIME

FIGURE 19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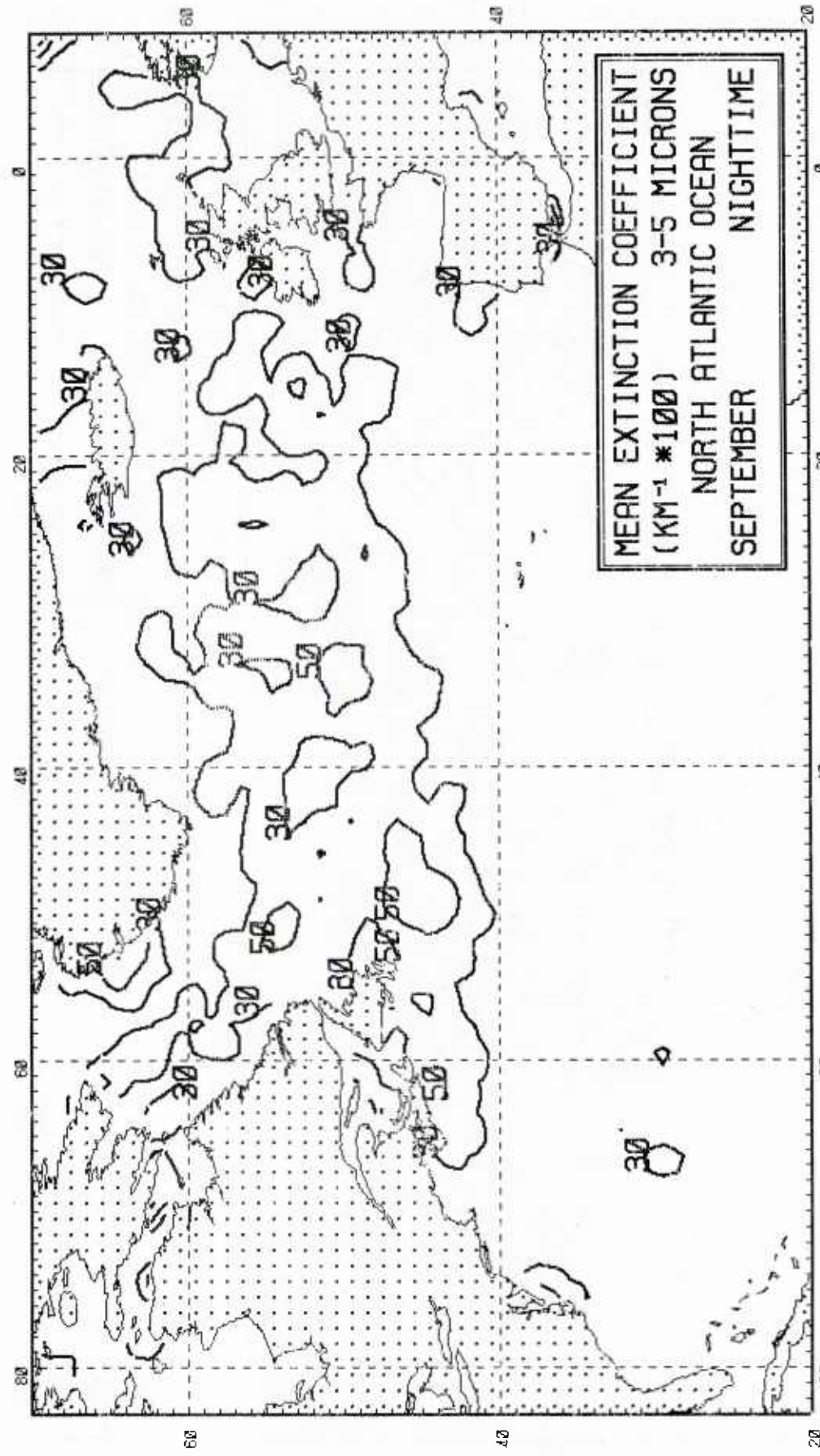
NORTH ATLANTIC OCEAN
AUGUST NIGHTTIME

FIGURE 20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(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
SEPTEMBER NIGHTTIME
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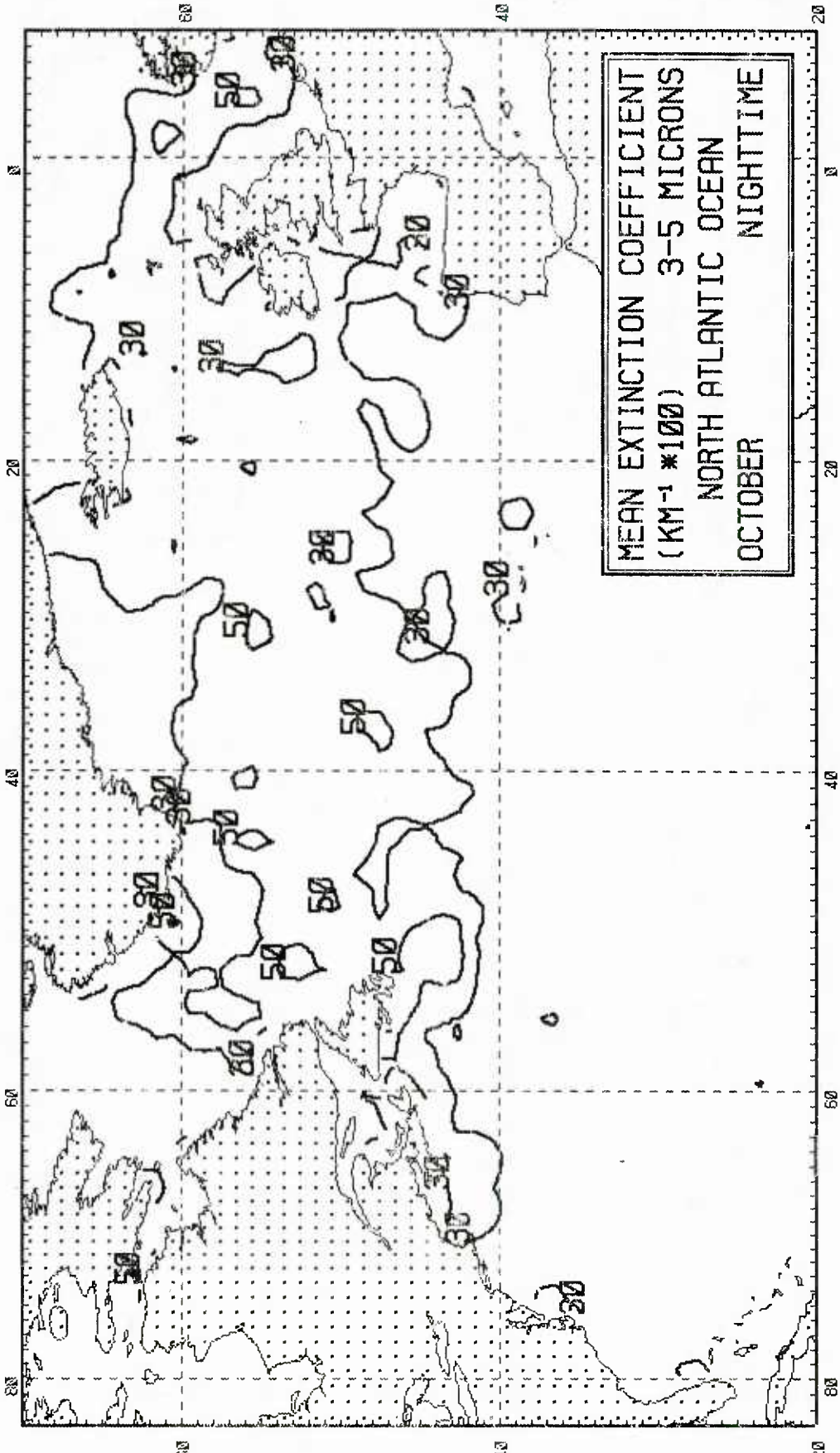
40
20
0
20
40
60
80
30
50

FIGURE 21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(KM-1 *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
OCTOBER NIGHTTIME
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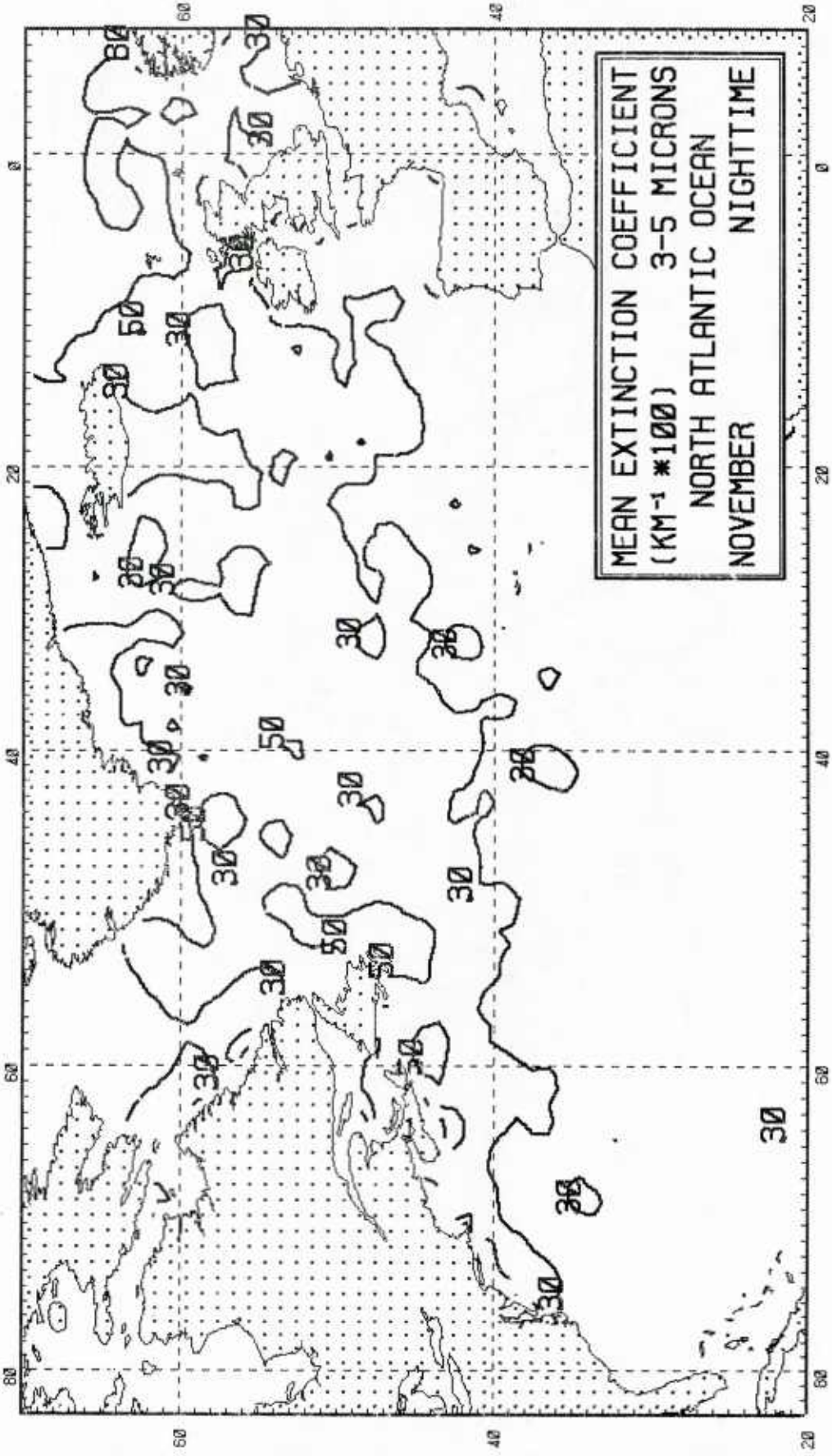
50

FIGURE 22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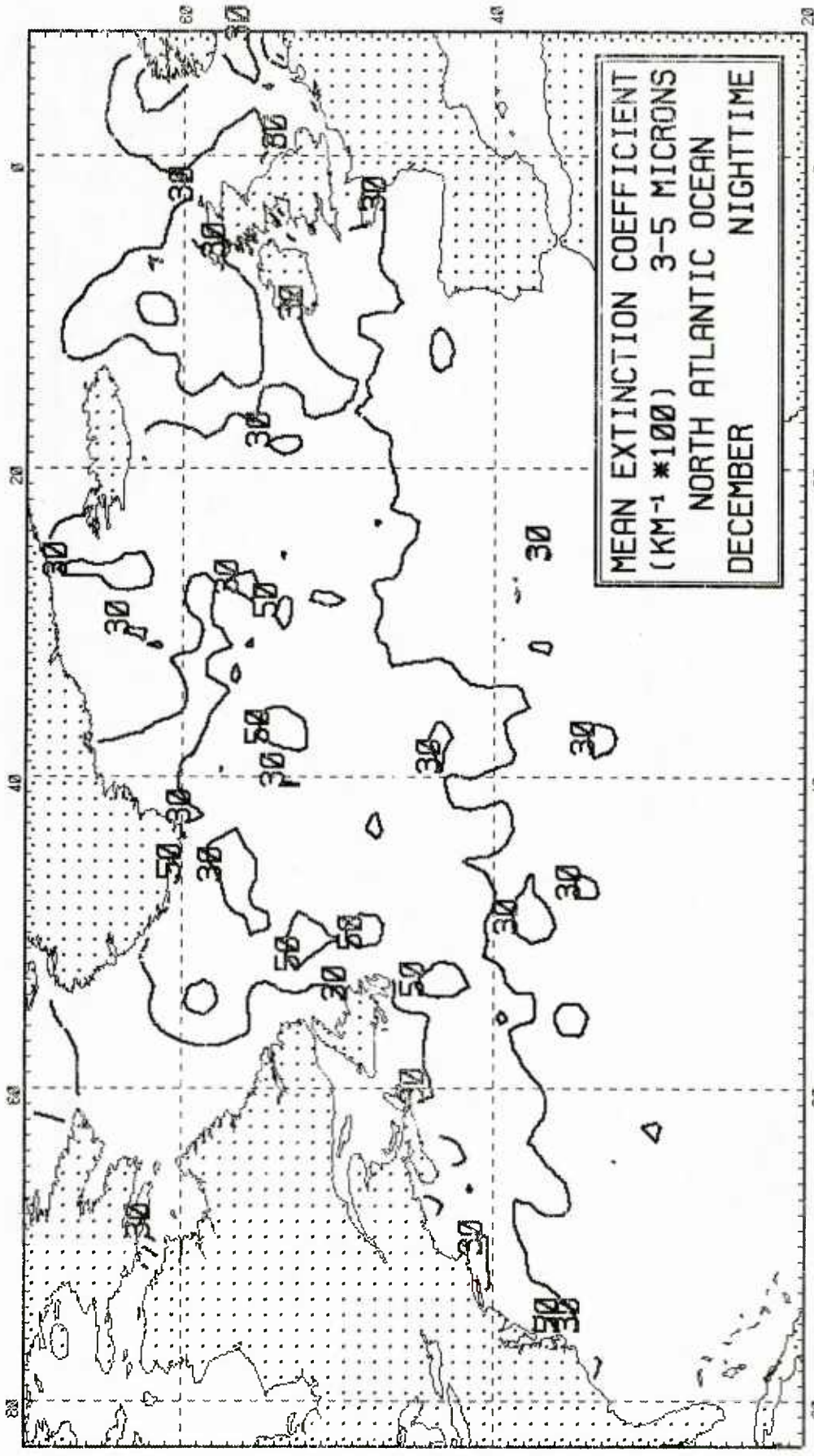
3-5 MICRONS
NORTH ATLANTIC OCEAN
NOVEMBER
NIGHTTIME

FIGURE 23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NORTH ATLANTIC OCEAN
DECEMBER NIGHTTIME

FIGURE 24

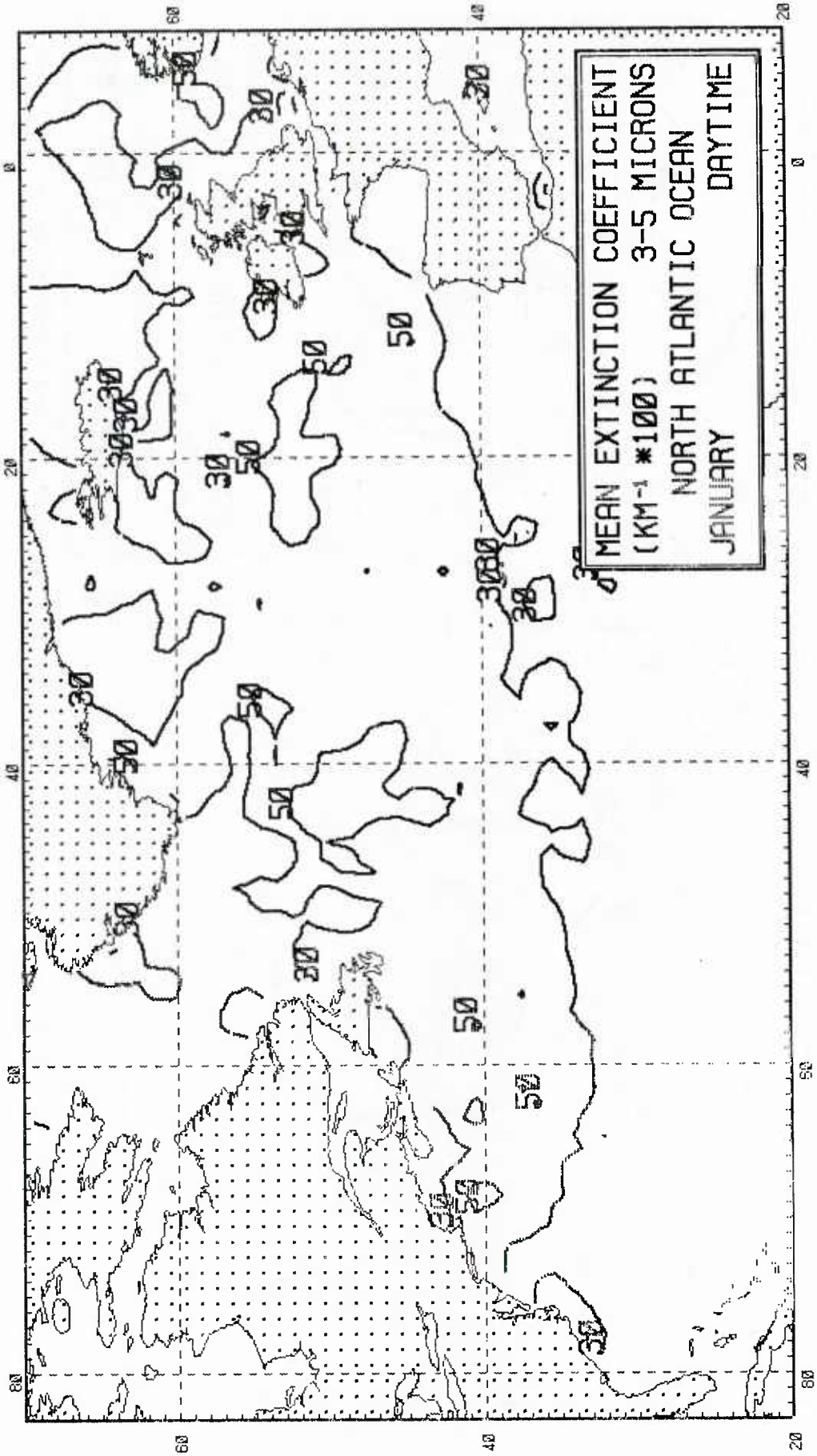
MEAN EXTINCTION COEFFICIENT
(KM-1 *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
JANUARY
DAYTIME

FIGURE 25

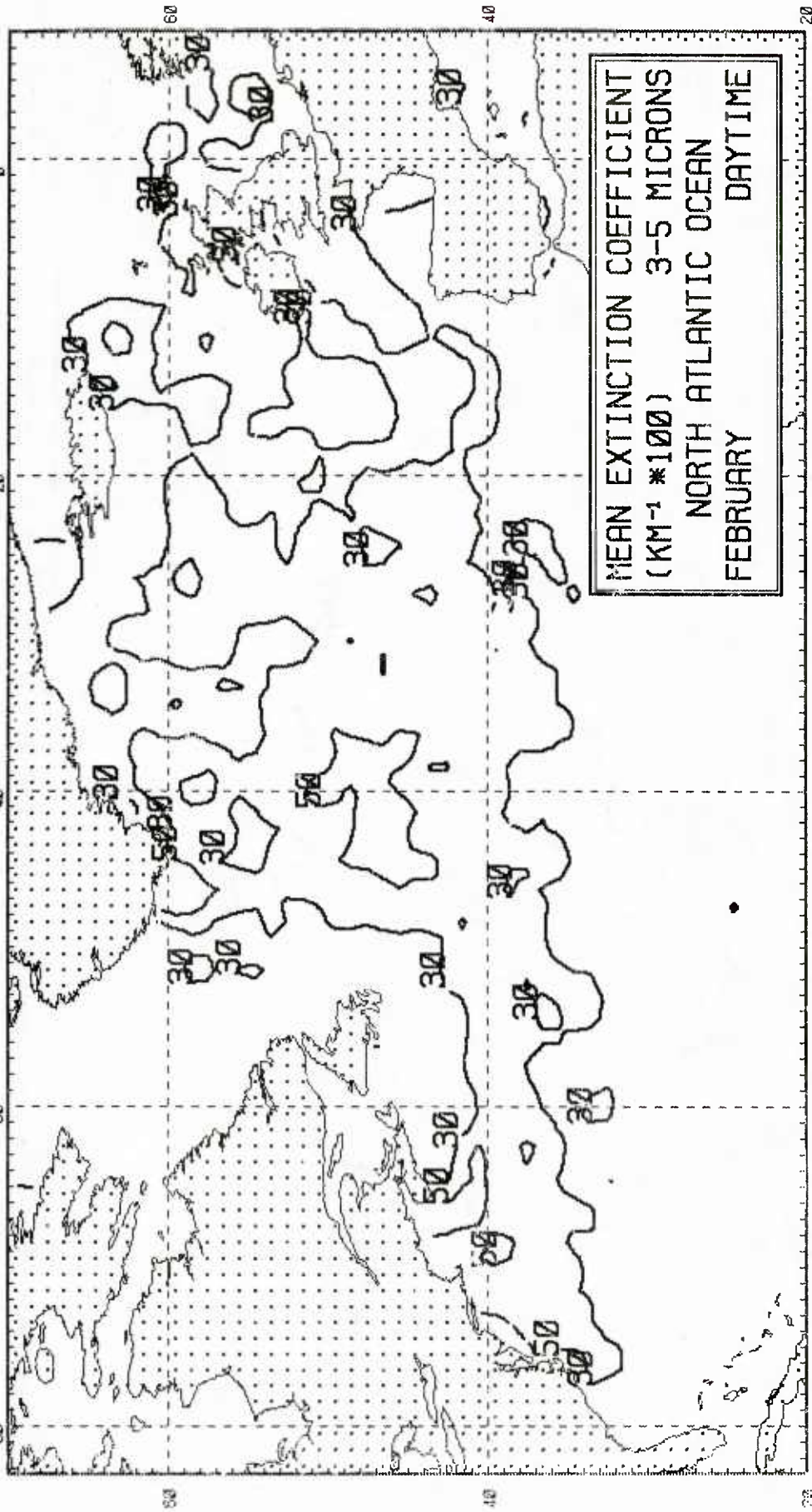
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
FEBRUARY DAYTIME

FIGURE 26

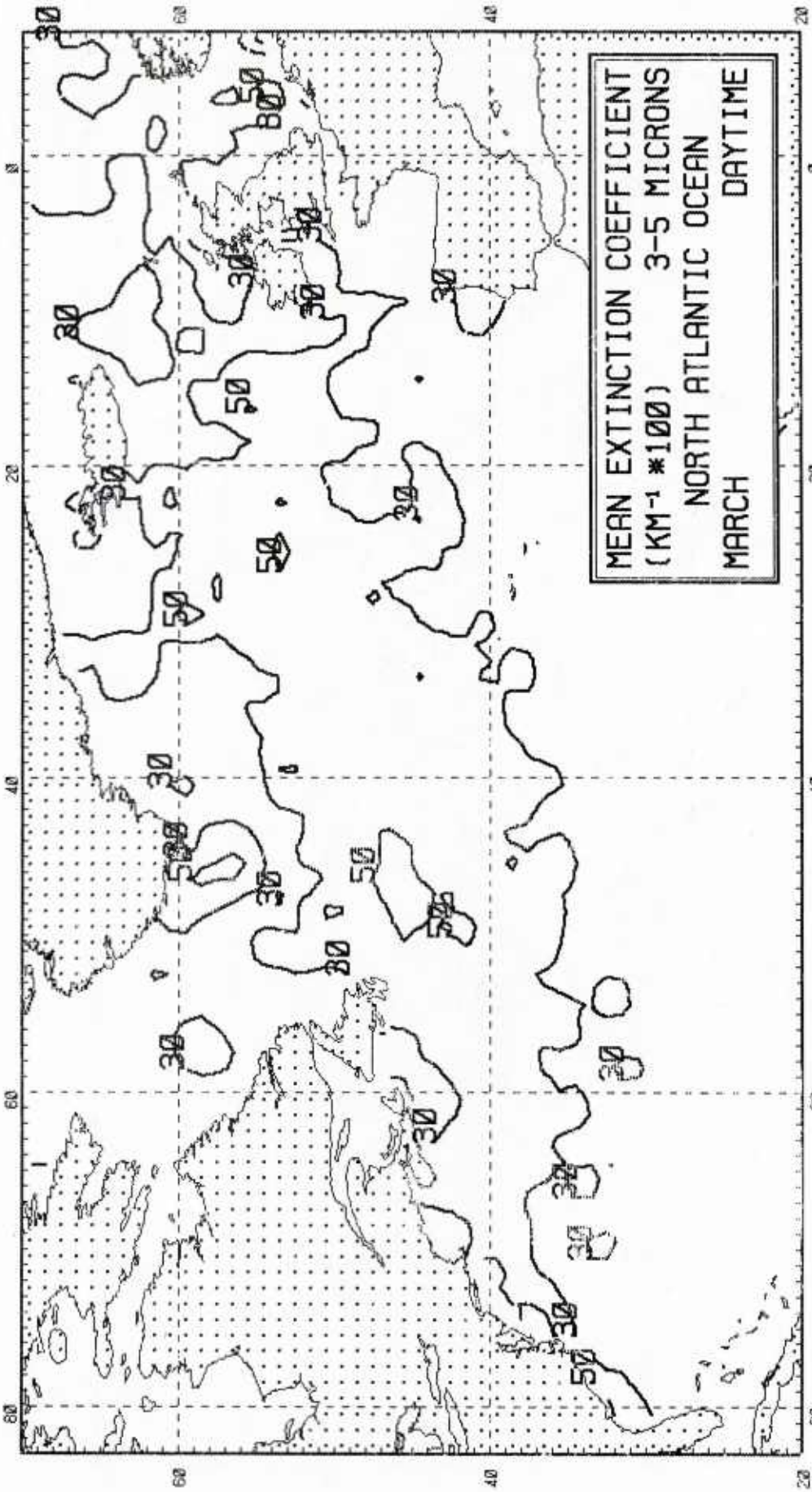
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
MARCH DAYTIME

FIGURE 27

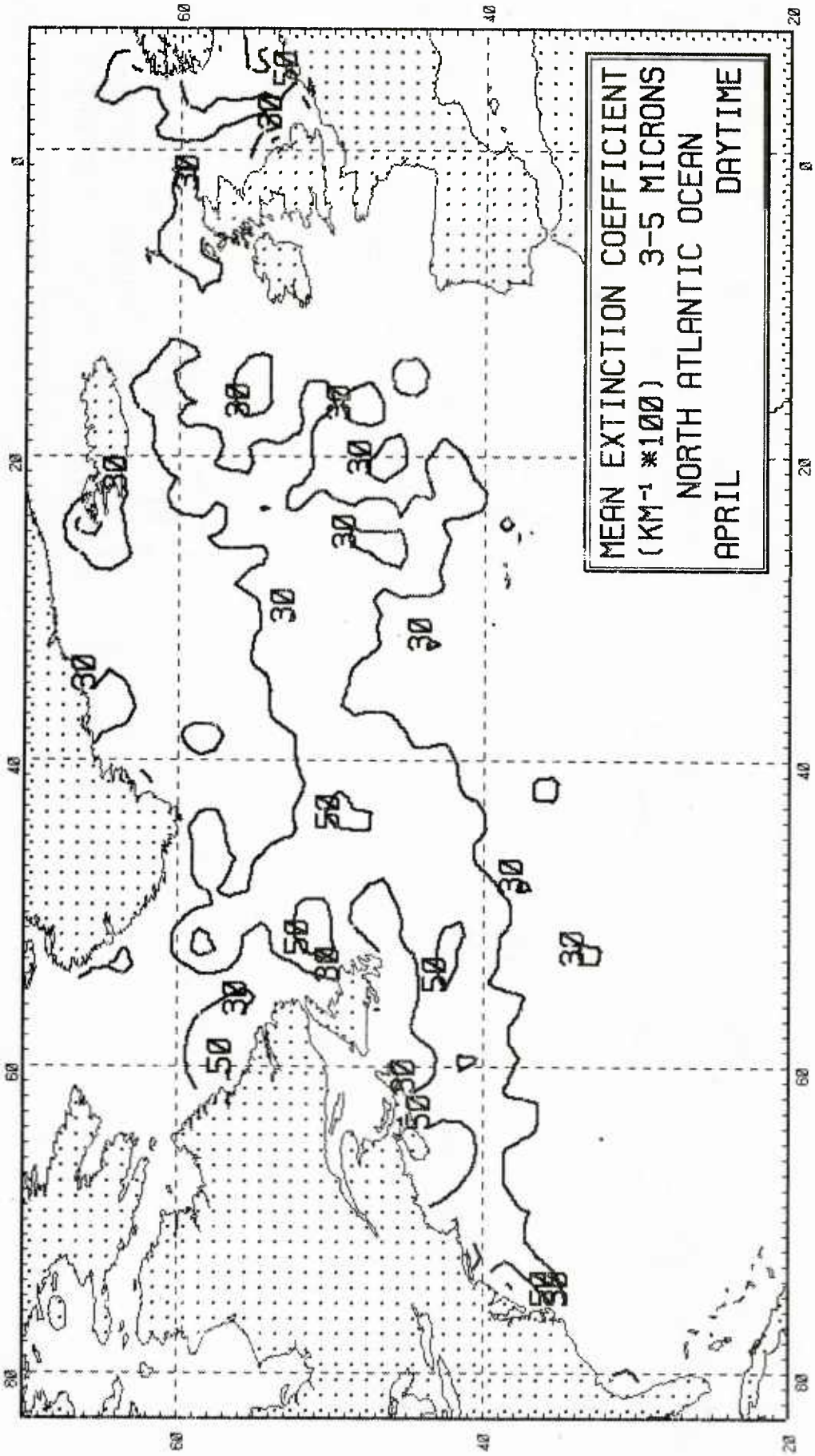
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
APRIL DAYTIME
60
40
20
0
20
40
60
80
30
50

FIGURE 28

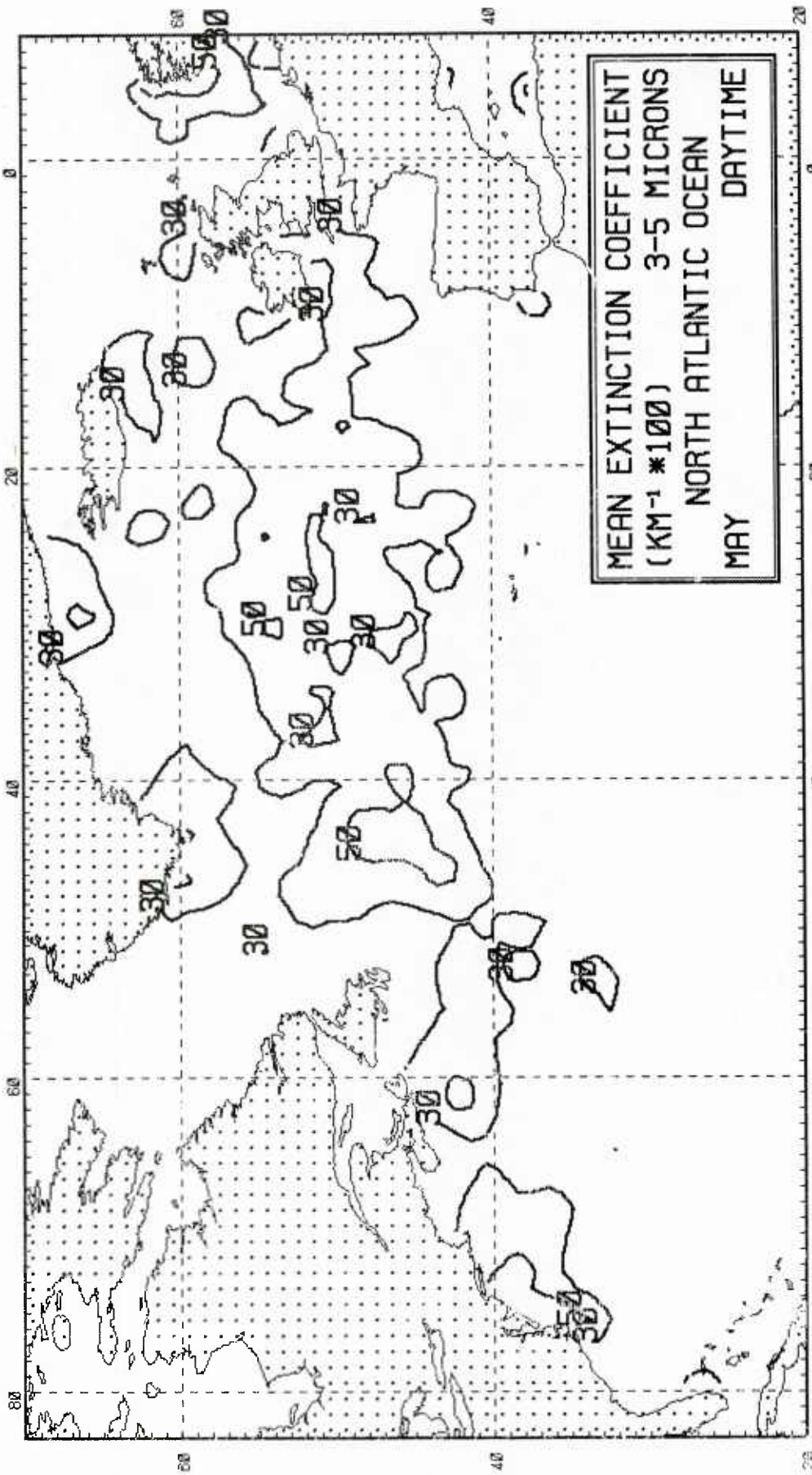
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
MAY DAYTIME

FIGURE 29

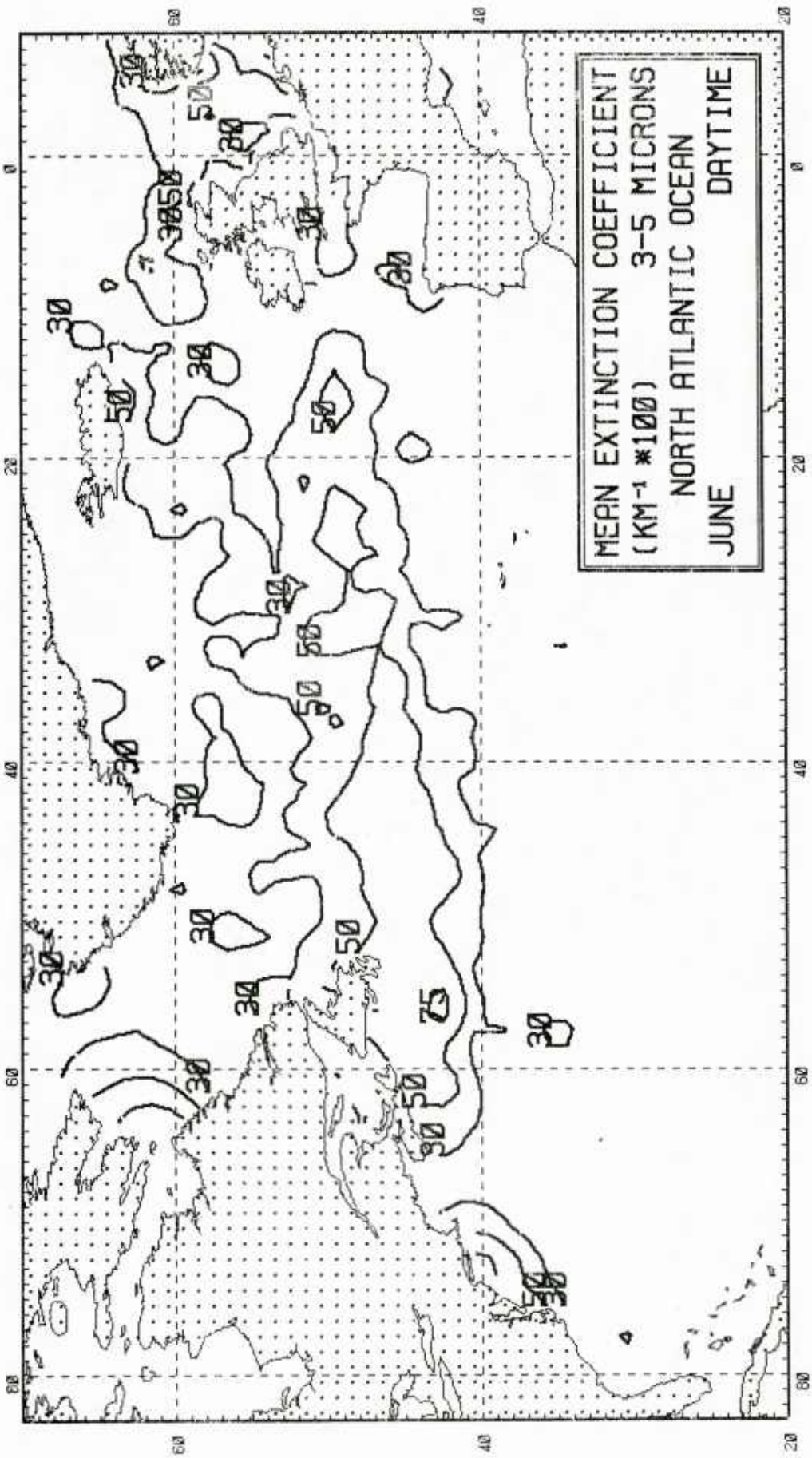
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JUNE DAYTIME
0
20
40
60
80
30
50
75

FIGURE 30

MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JULY DAYTIME

FIGURE 31

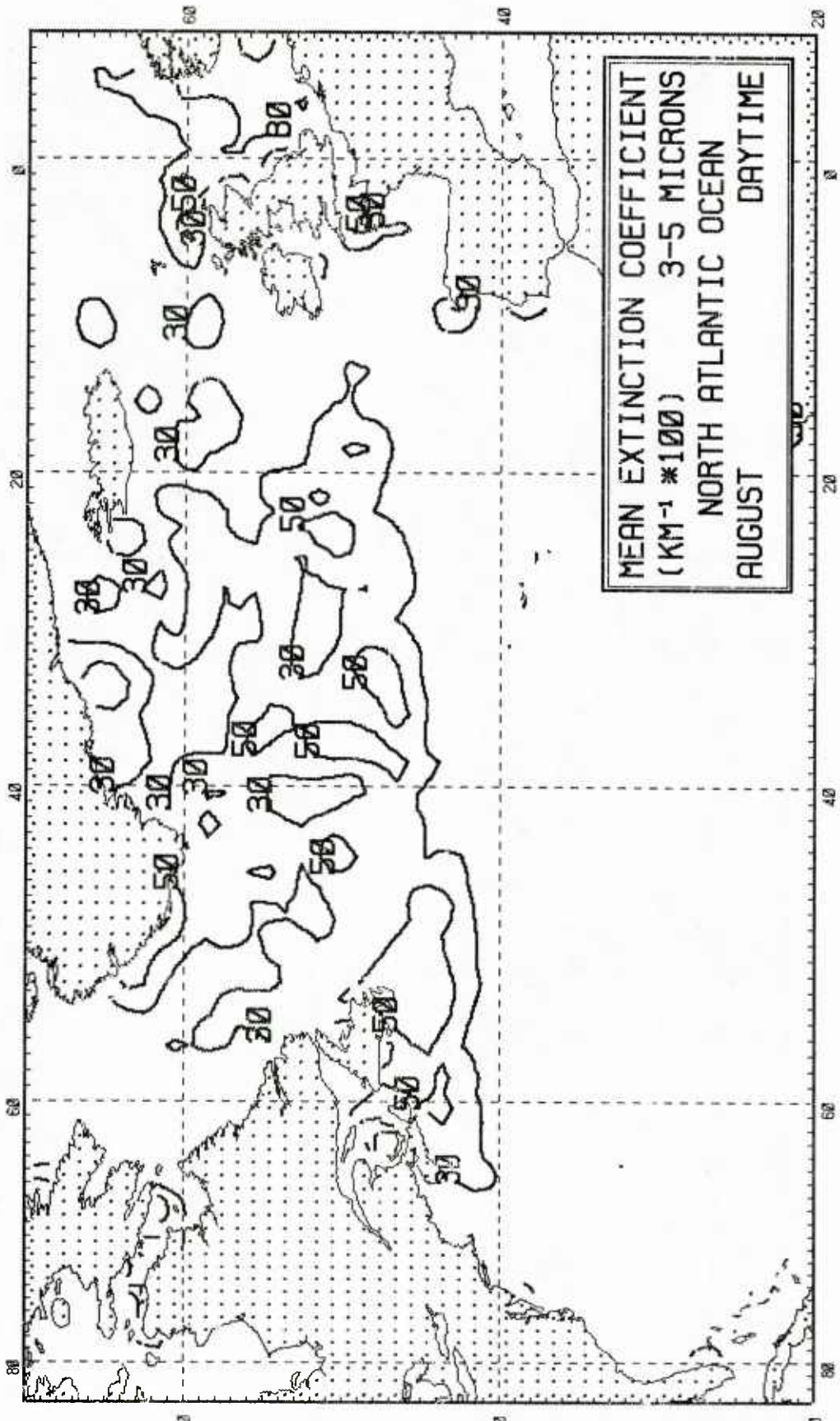
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
AUGUST DAYTIME
80
60
40
20
0
20
40
60
80

FIGURE 32

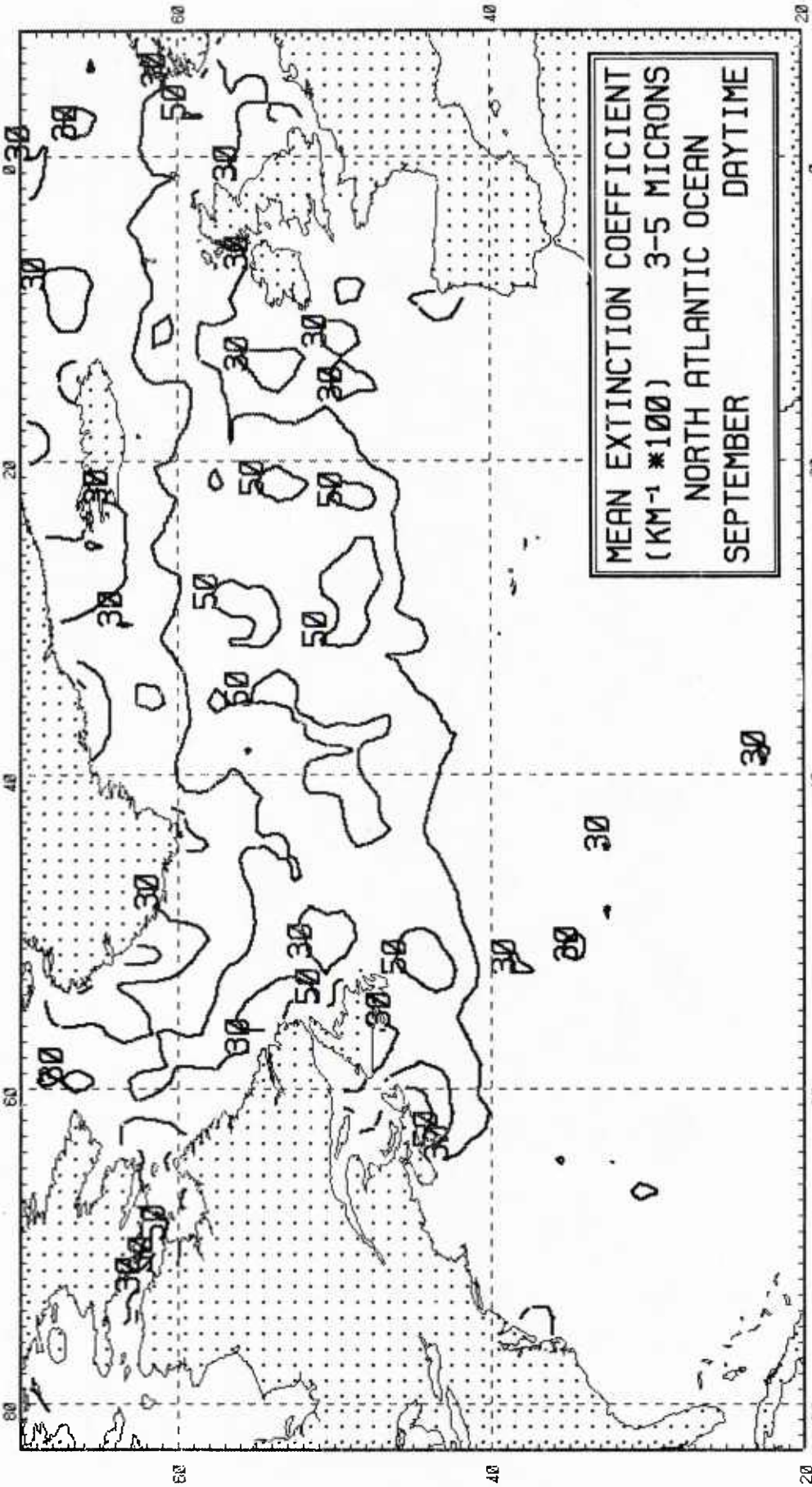
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
SEPTEMBER DAYTIME

FIGURE 33

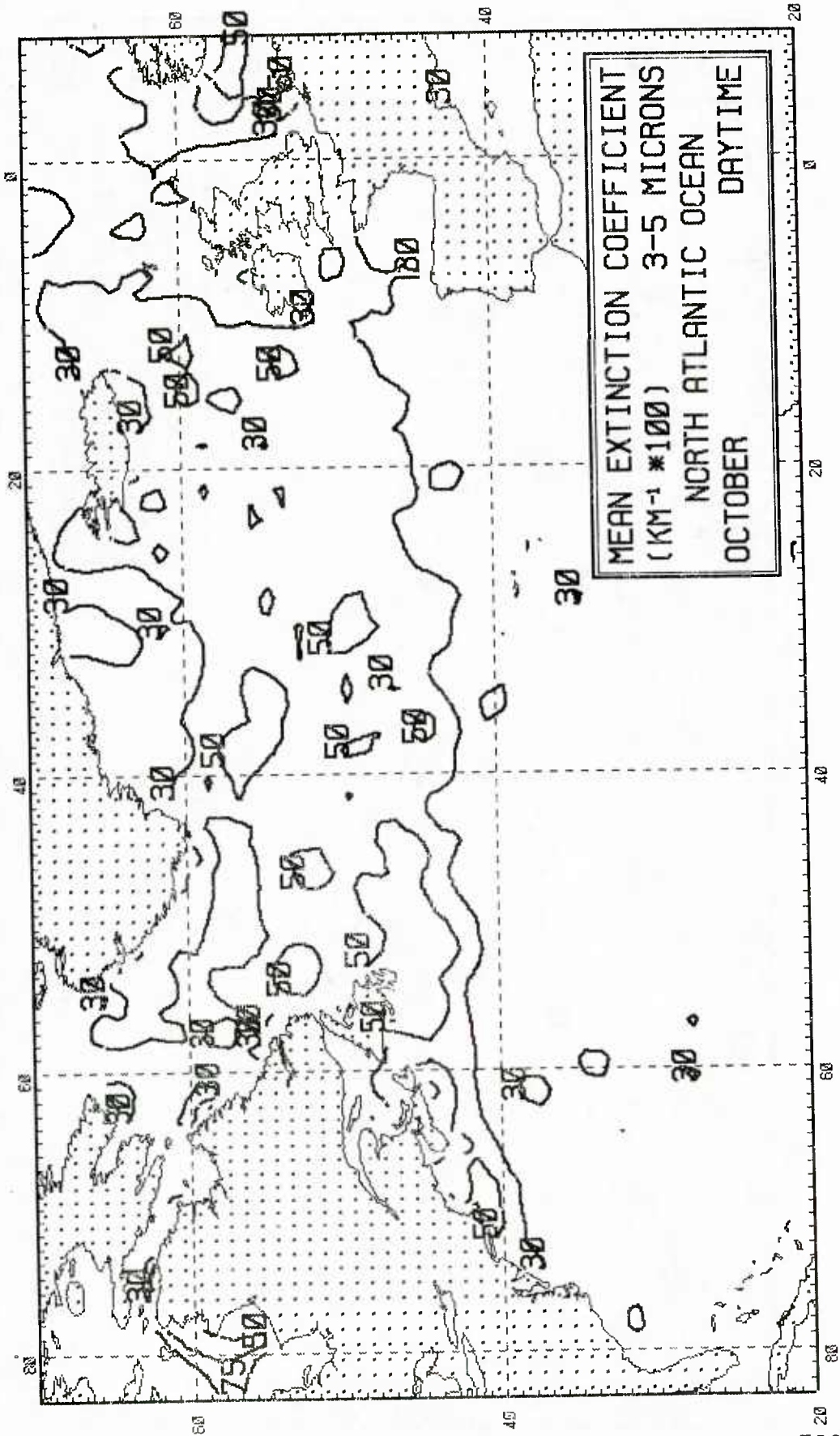
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
OCTOBER
DAYTIME

FIGURE 34

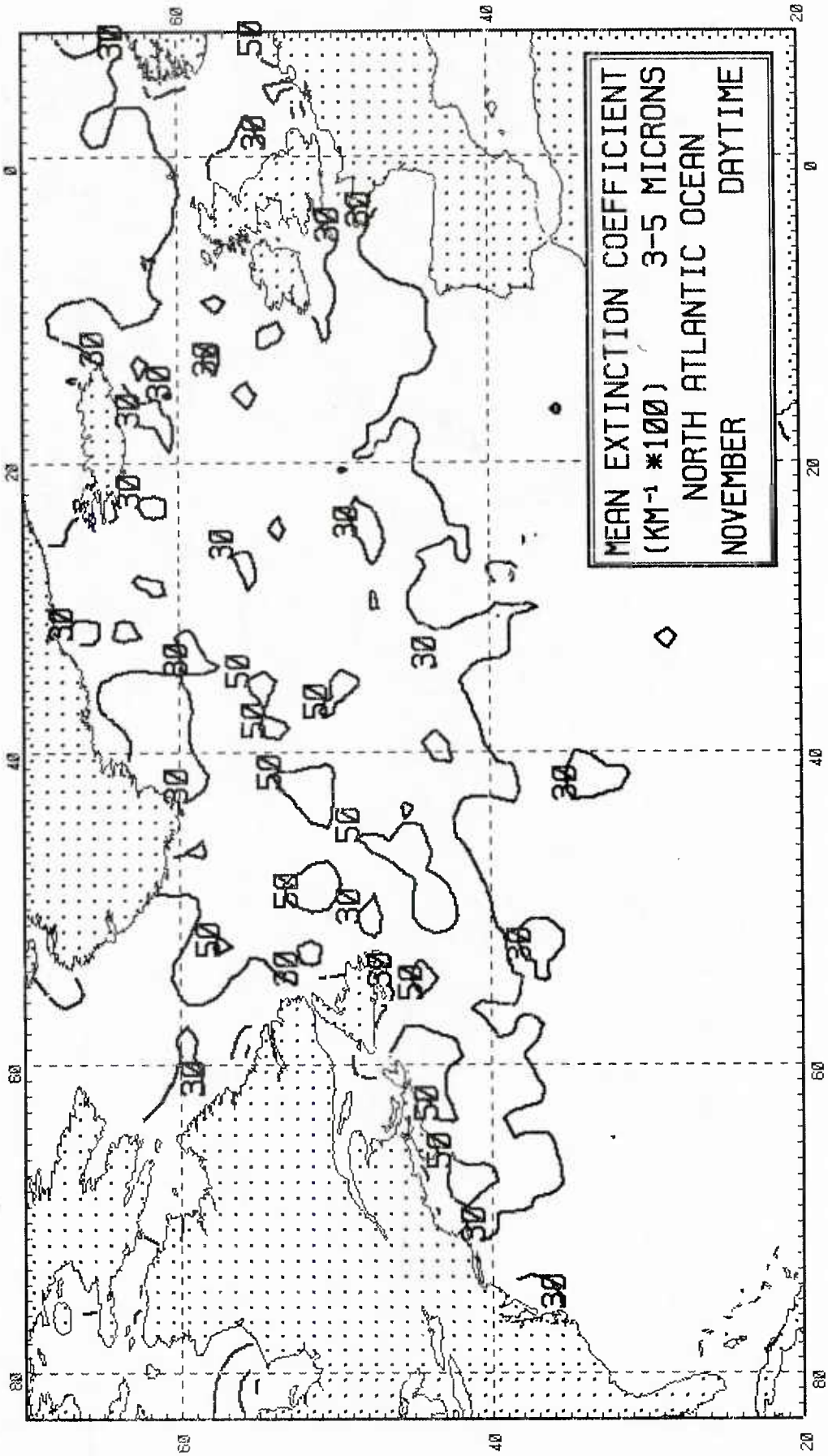
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
NOVEMBER
DAYTIME

FIGURE 35

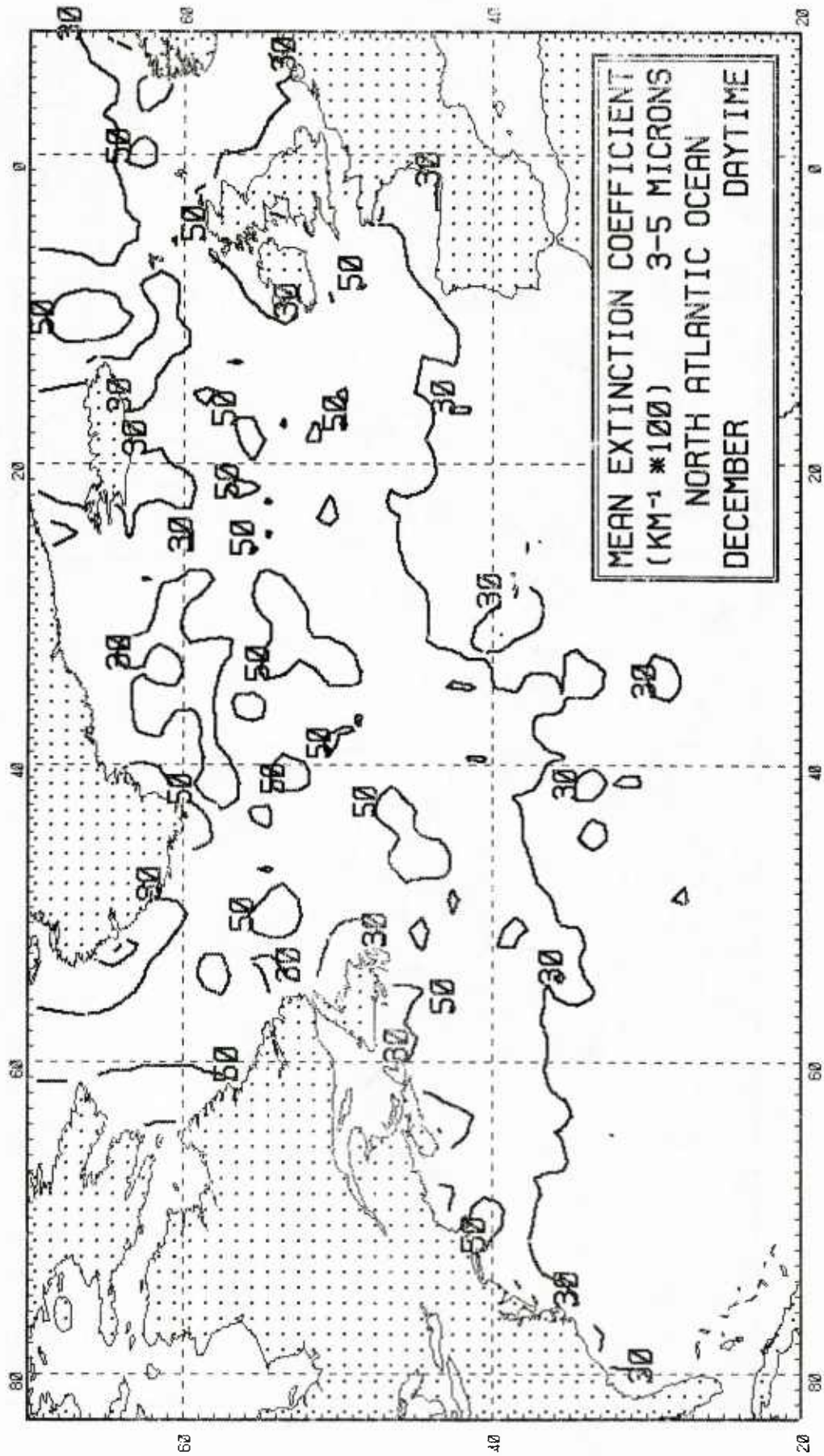
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
3-5 MICRONS
NORTH ATLANTIC OCEAN
DECEMBER
DAYTIME

FIGURE 36

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JANUARY ALL HOURS

FIGURE 37

MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
FEBRUARY ALL HOURS
80
60
40
20
0
20
40
60
80
0
30
50

FIGURE 38

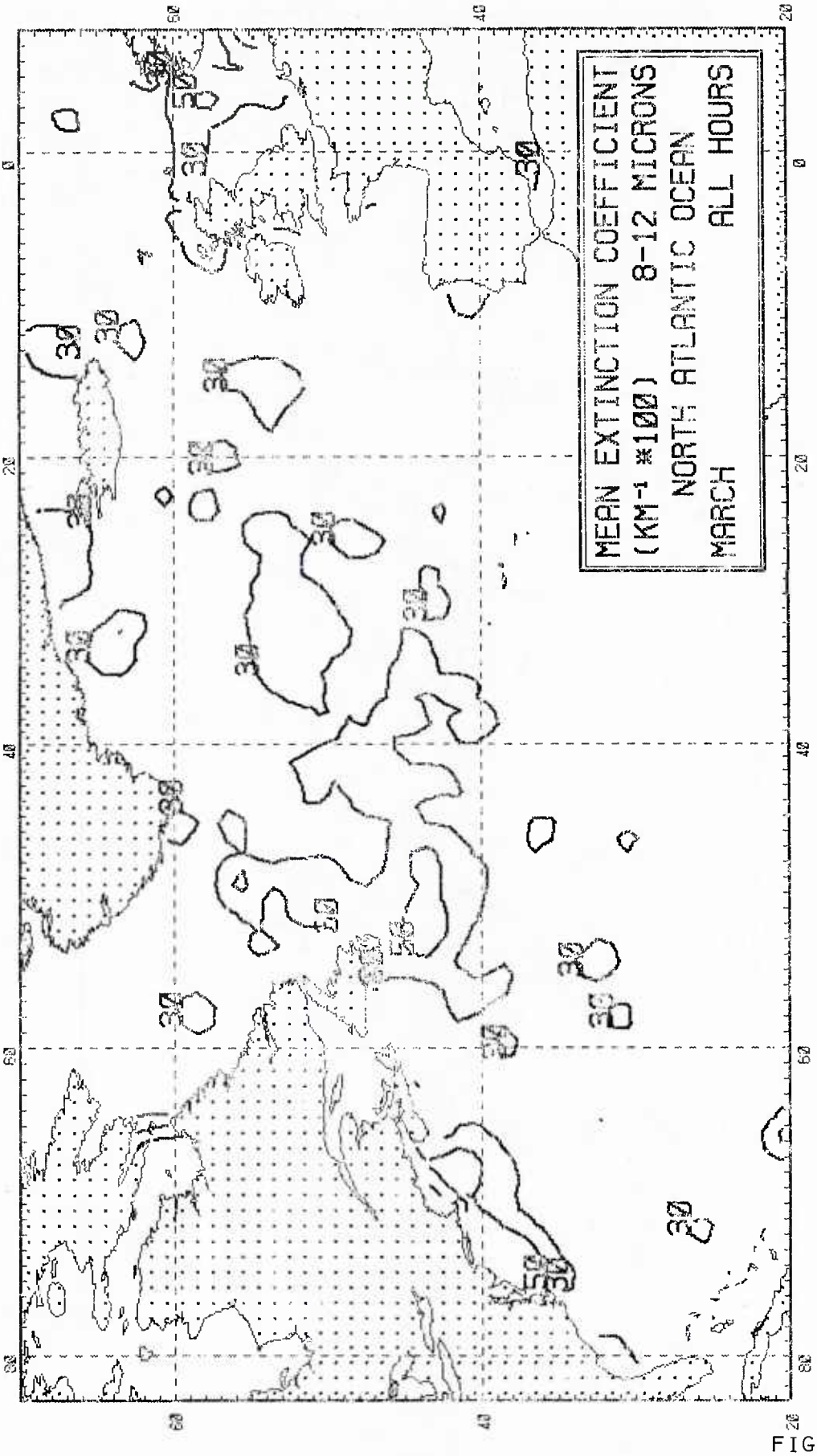
MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
MARCH ALL HOURS

FIGURE 39

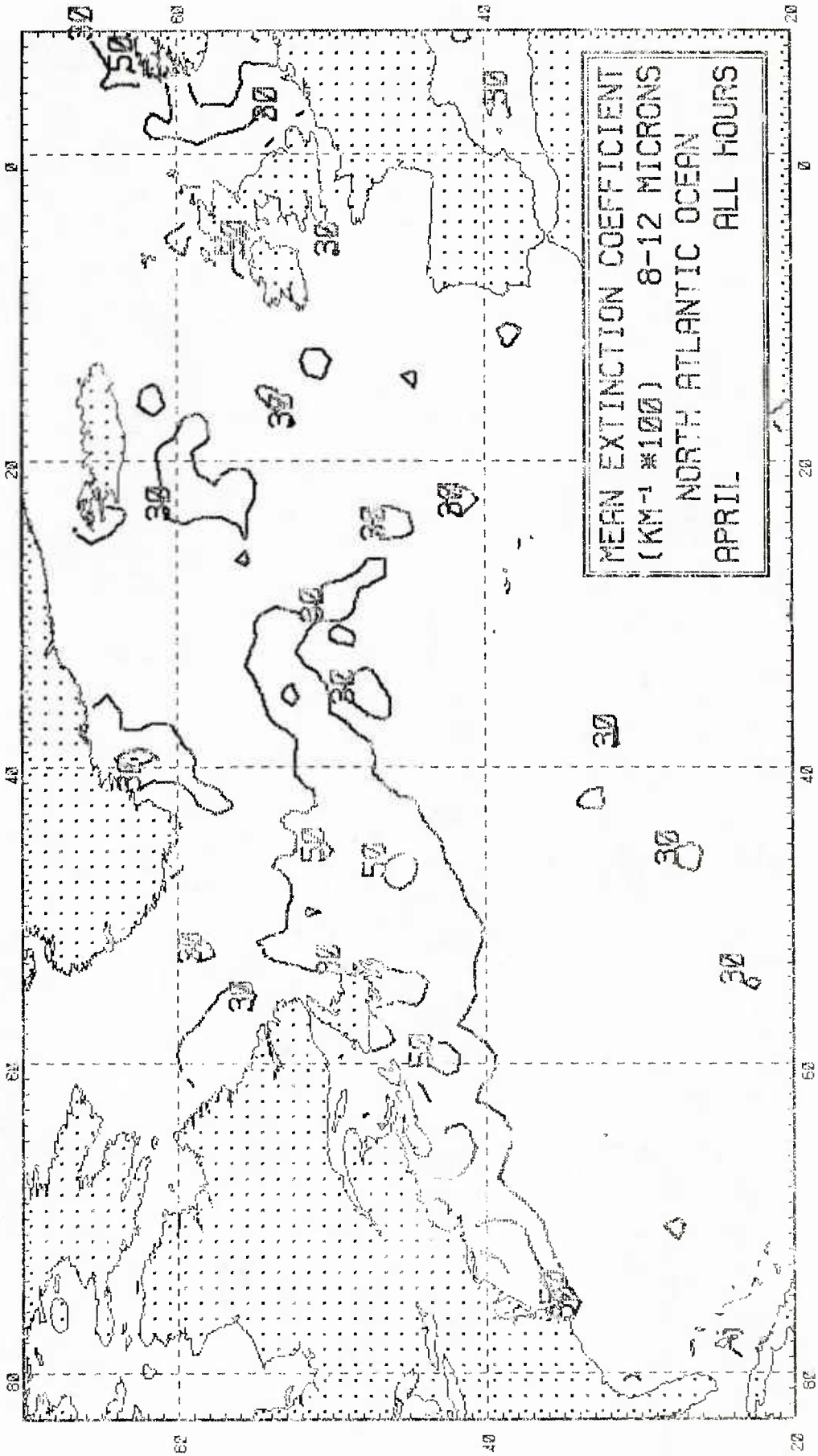
MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
APRIL ALL HOURS

FIGURE 40

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
MAY ALL HOURS

FIGURE 41

MEAN EXTINCTION COEFFICIENT
(KM-1 *100)
8-12 MICRONS
NORTH ATLANTIC OCEAN
JUNE
ALL HOURS

FIGURE 42

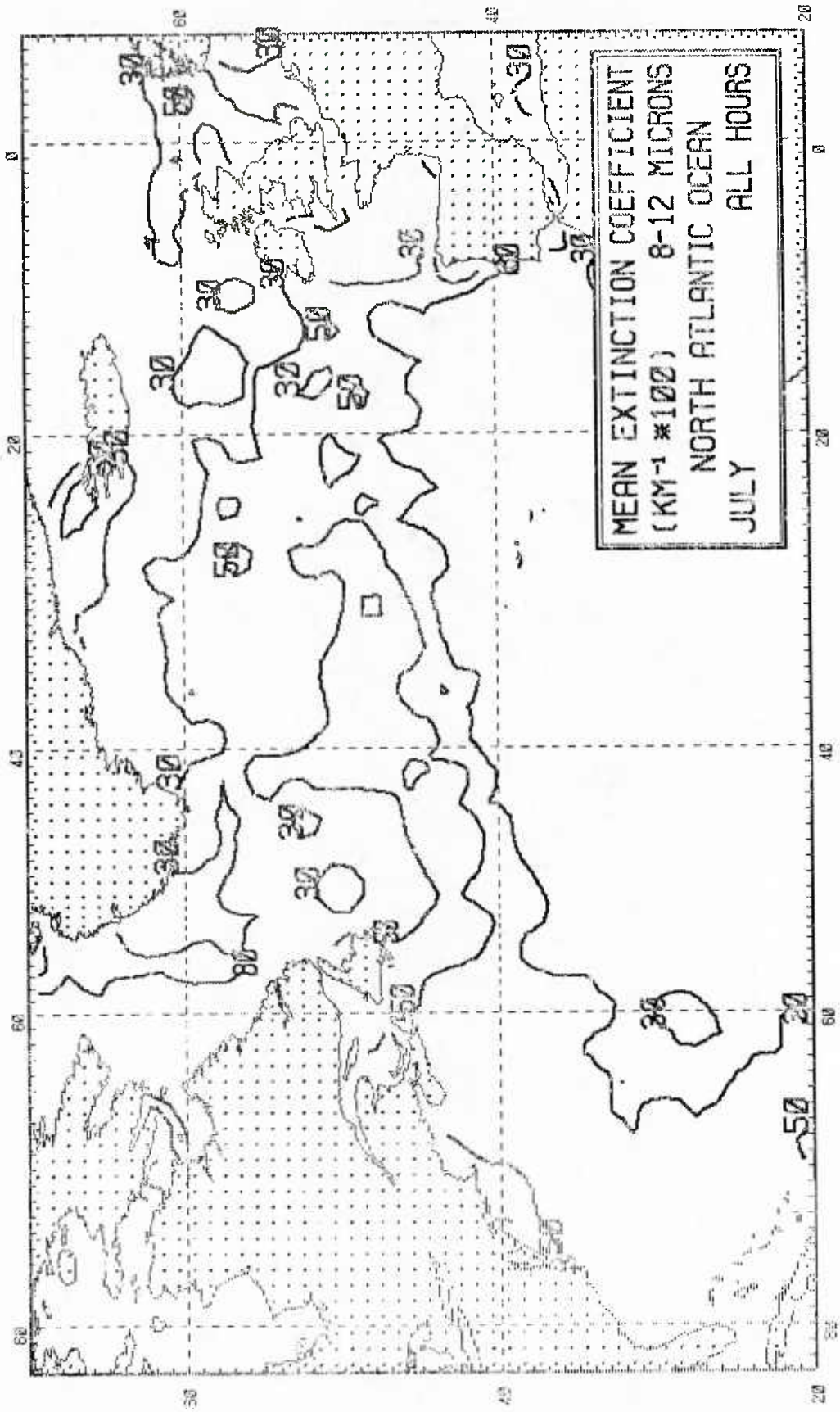
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JULY ALL HOURS

FIGURE 43

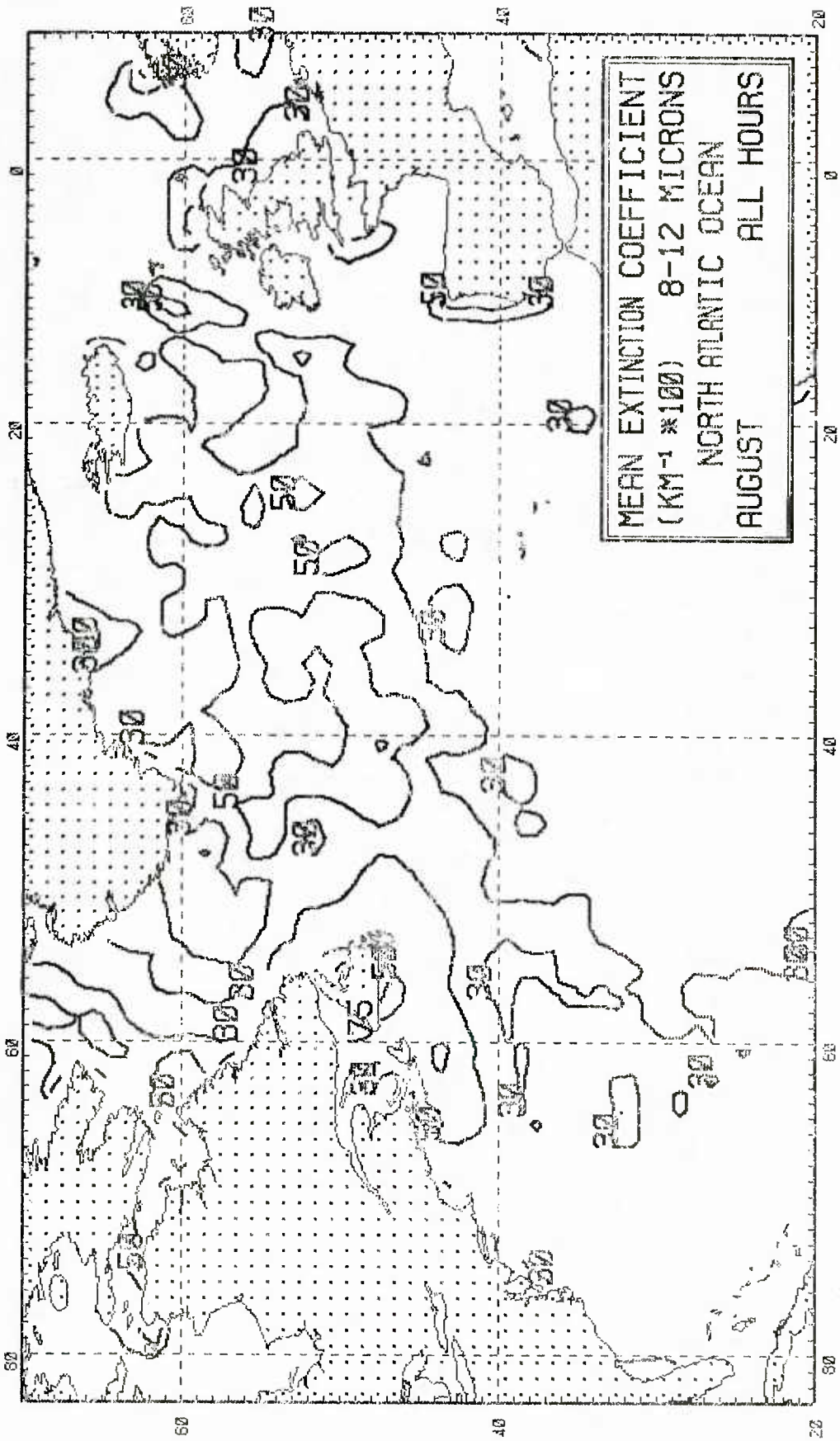
MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
AUGUST ALL HOURS

FIGURE 44

MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
SEPTEMBER ALL HOURS

FIGURE 45

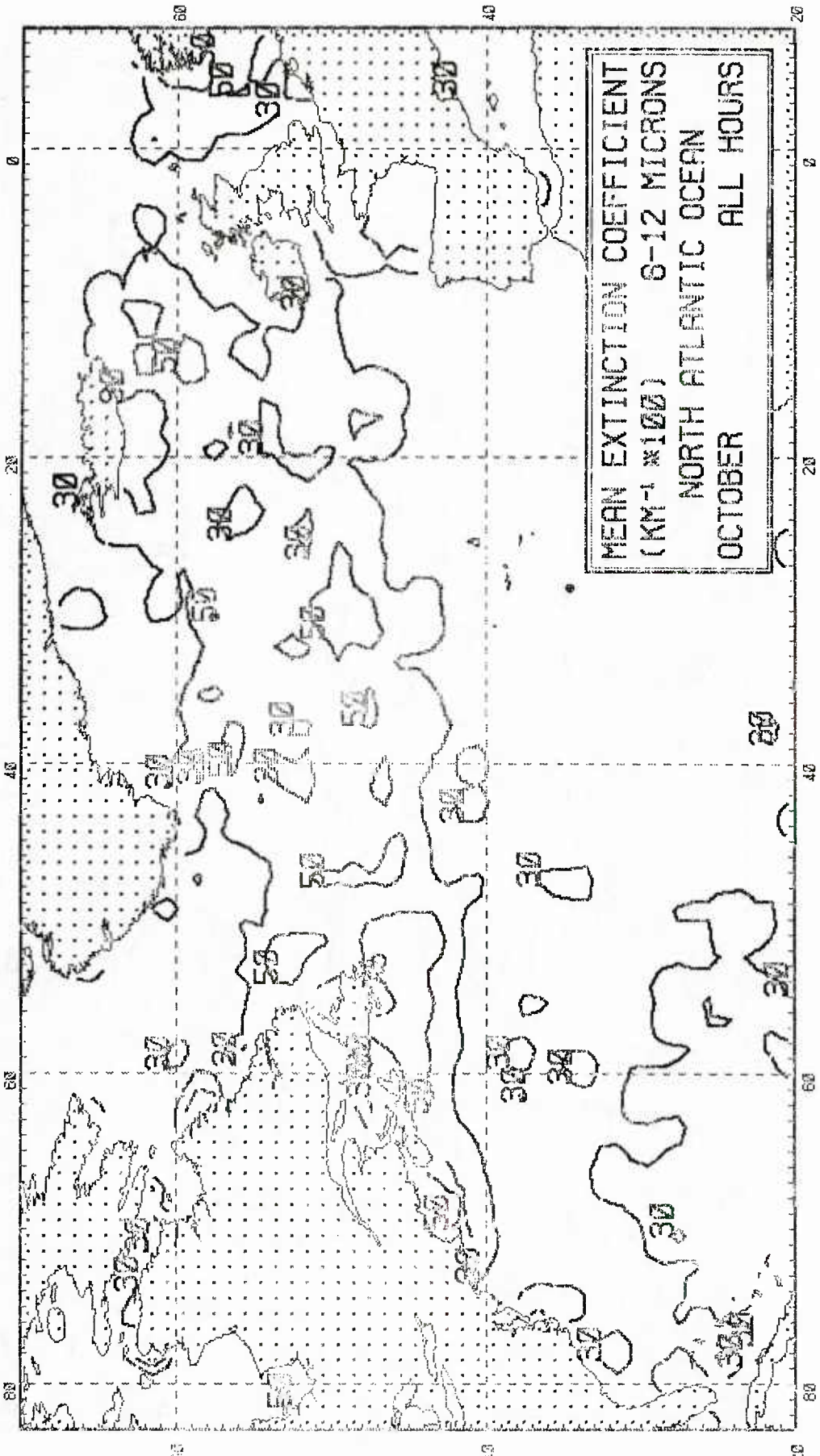
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ ×10Ø) 8-12 MICRONS
NORTH ATLANTIC OCEAN
OCTOBER ALL HOURS

FIGURE 46

MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
NOVEMBER ALL HOURS

FIGURE 47

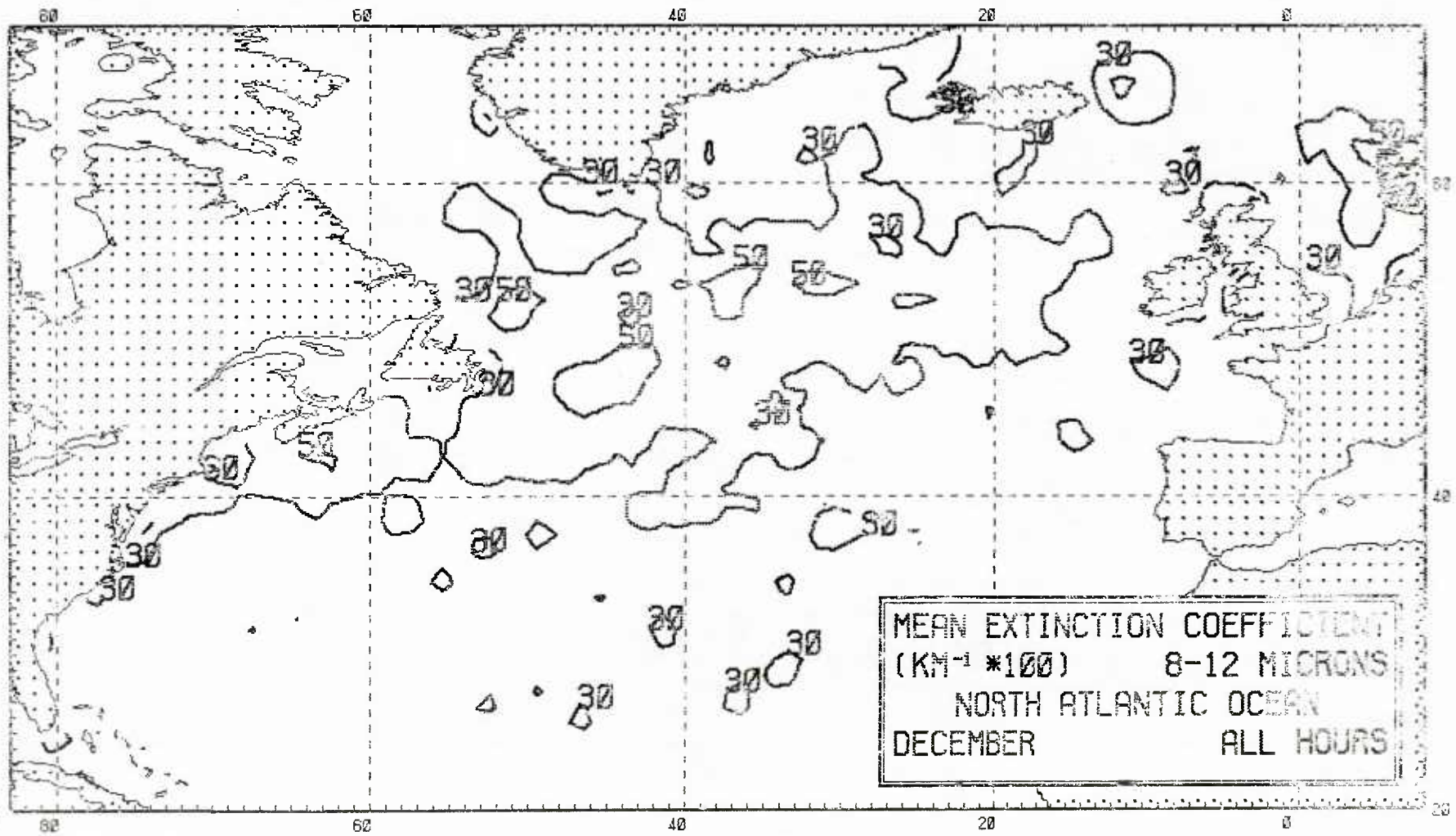
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
DECEMBER ALL HOURS

FIGURE 48

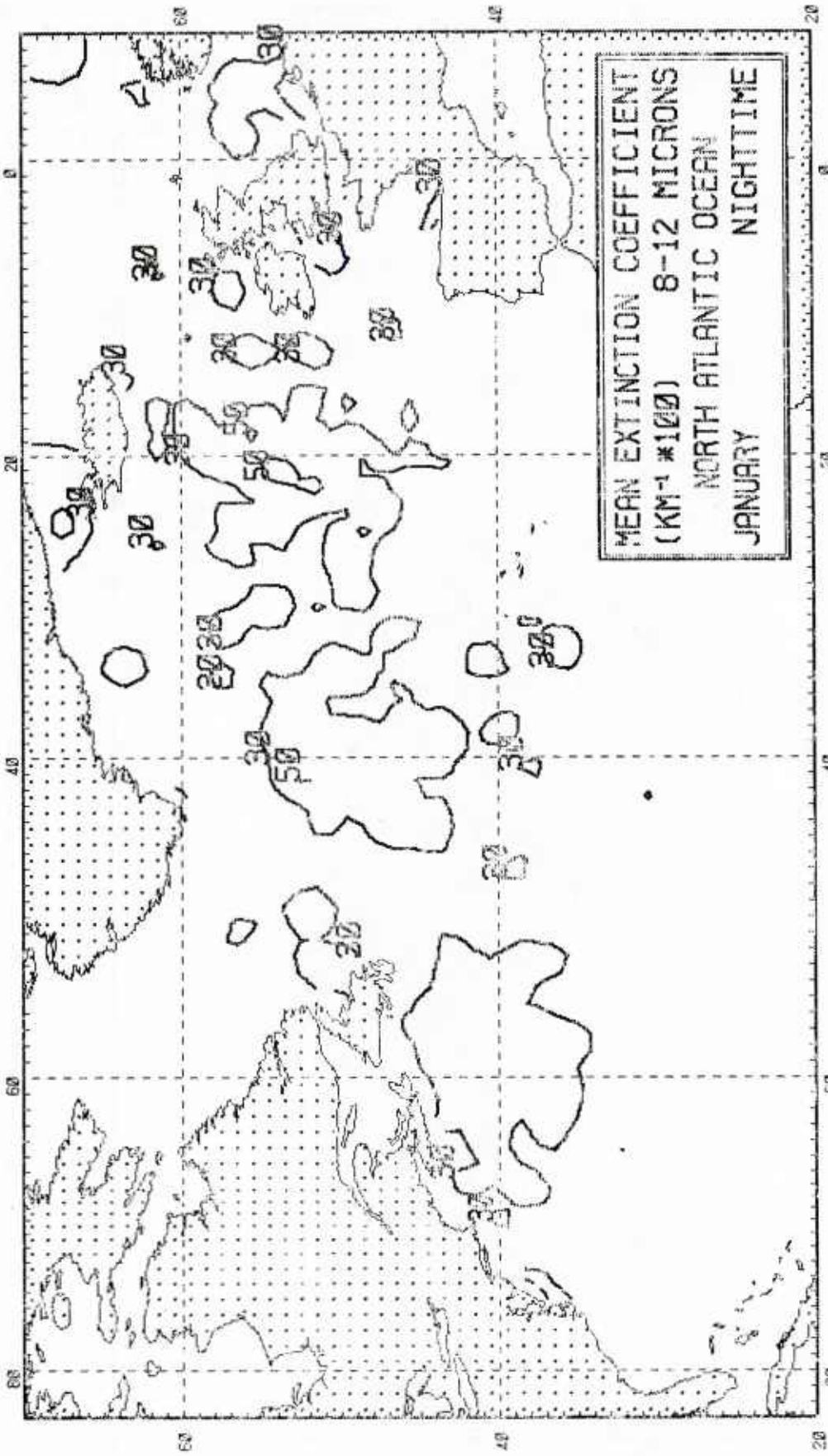
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JANUARY NIGHTTIME

FIGURE 49

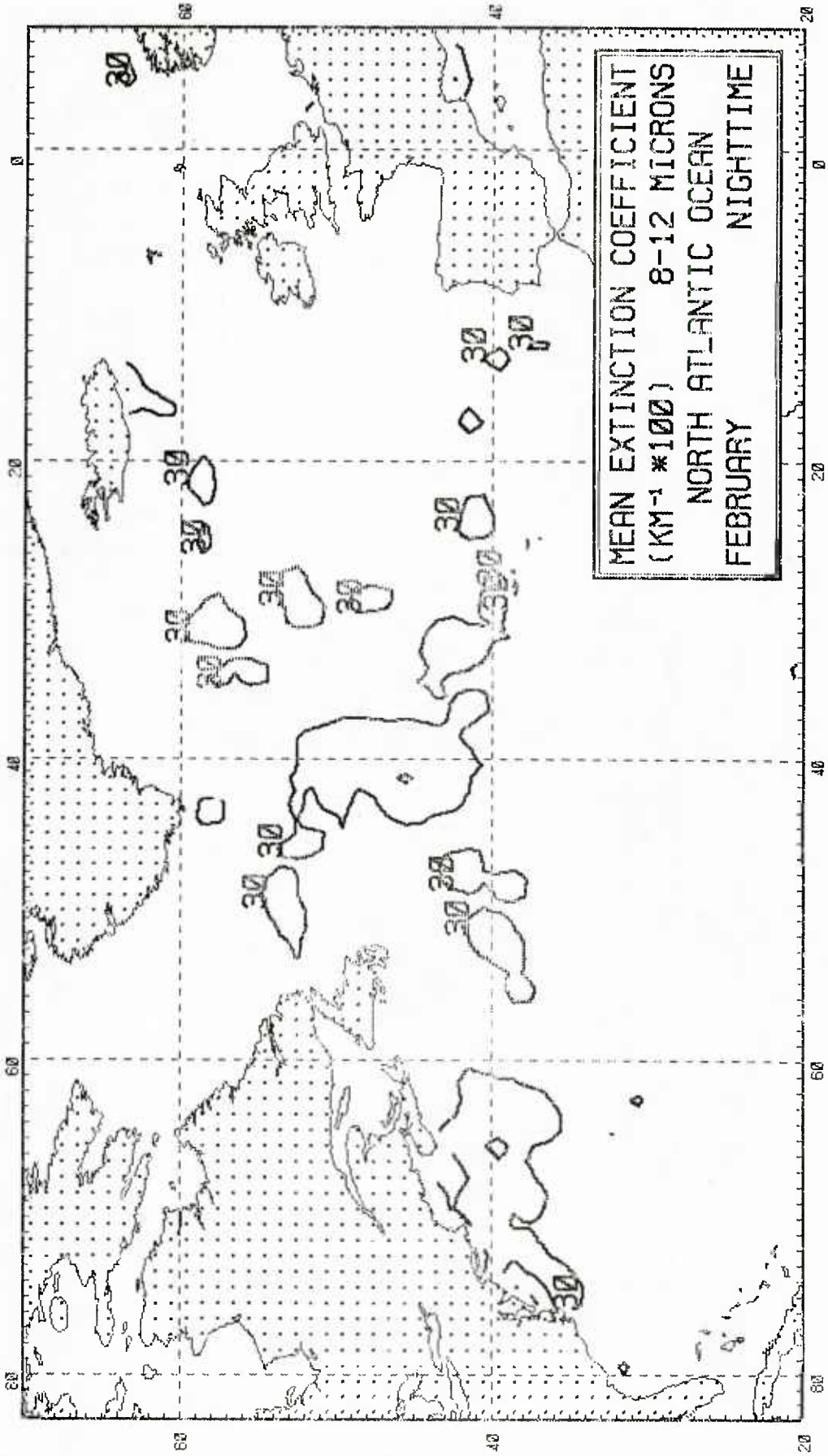
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
FEBRUARY NIGHTTIME
30
0
20
40
60
80

FIGURE 50

MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
MARCH NIGHTTIME

FIGURE 51

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
APRIL NIGHTTIME

FIGURE 52

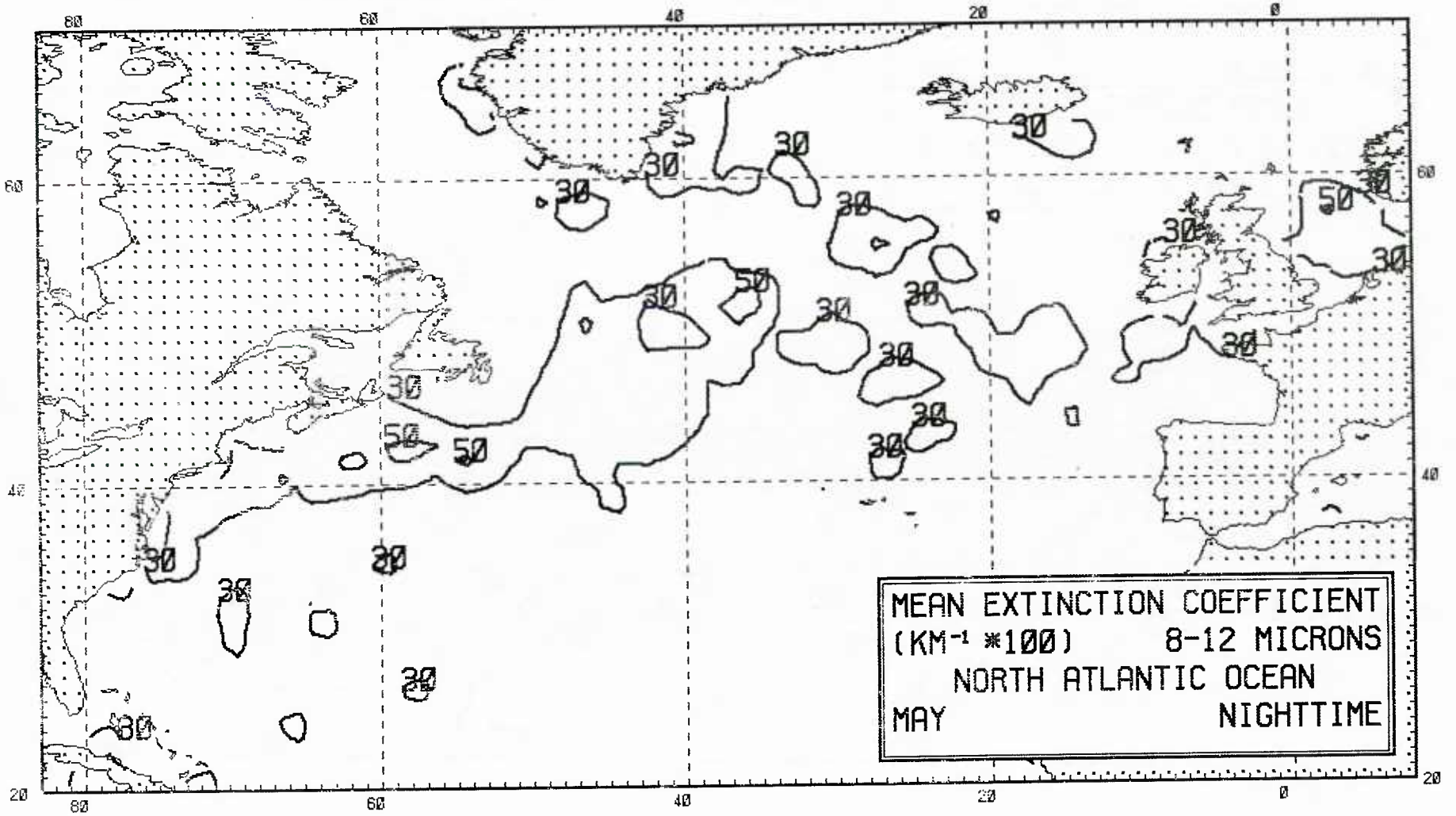
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
MAY NIGHTTIME

FIGURE 53

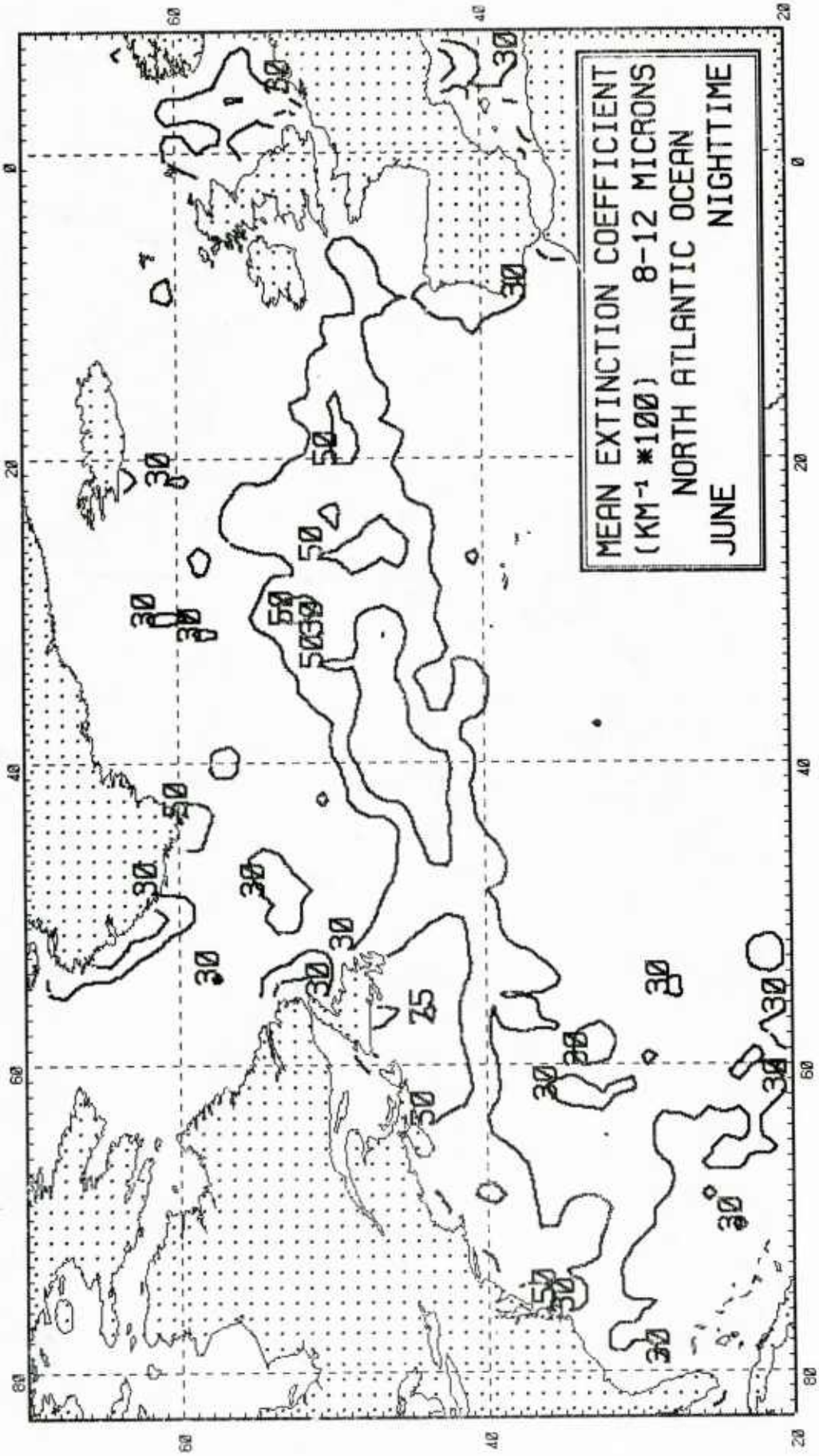
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JUNE NIGHTTIME
60
40
20
0
20
40
60
80
30
50
75

FIGURE 54

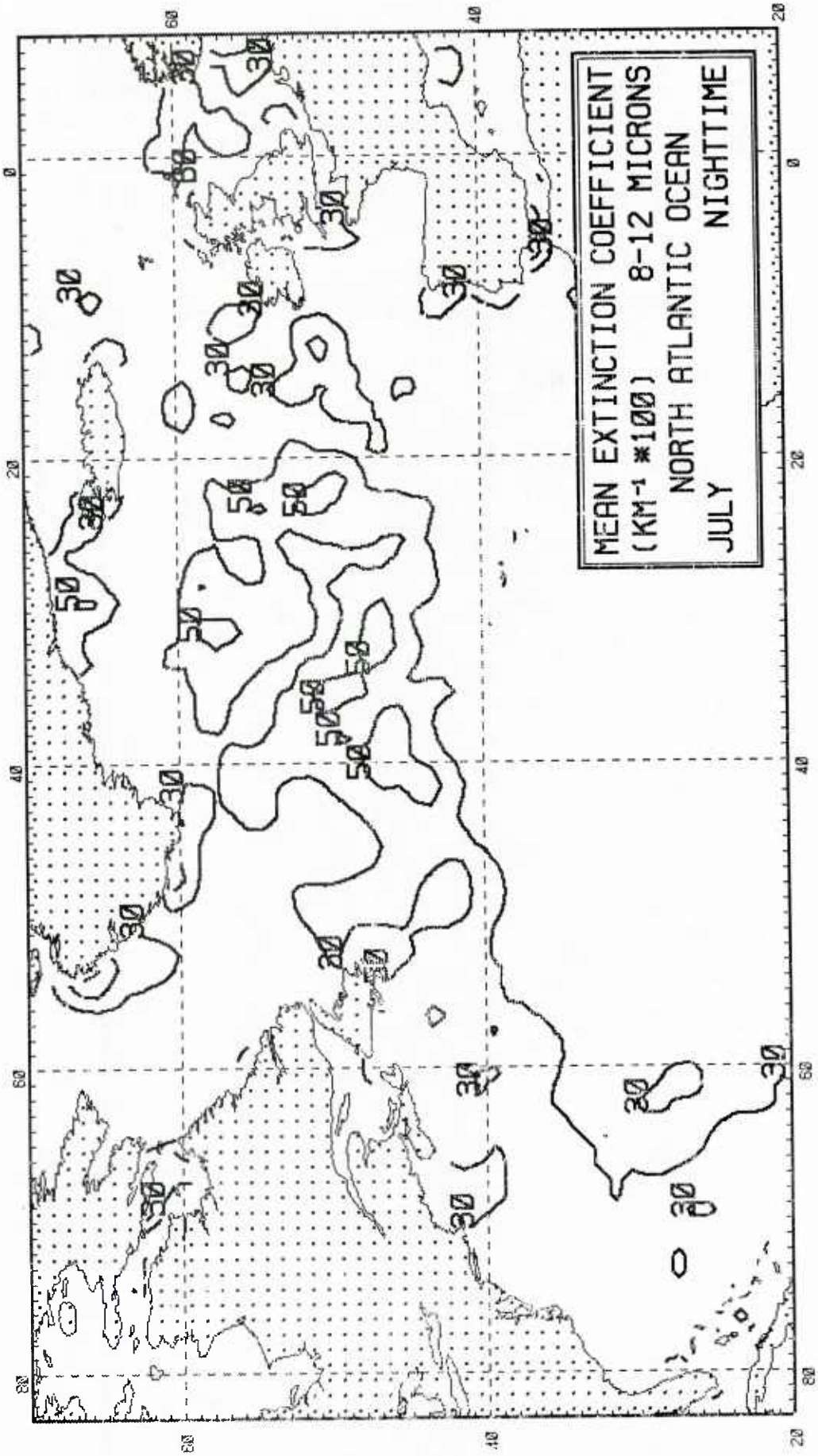
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JULY
NIGHTTIME

FIGURE 55

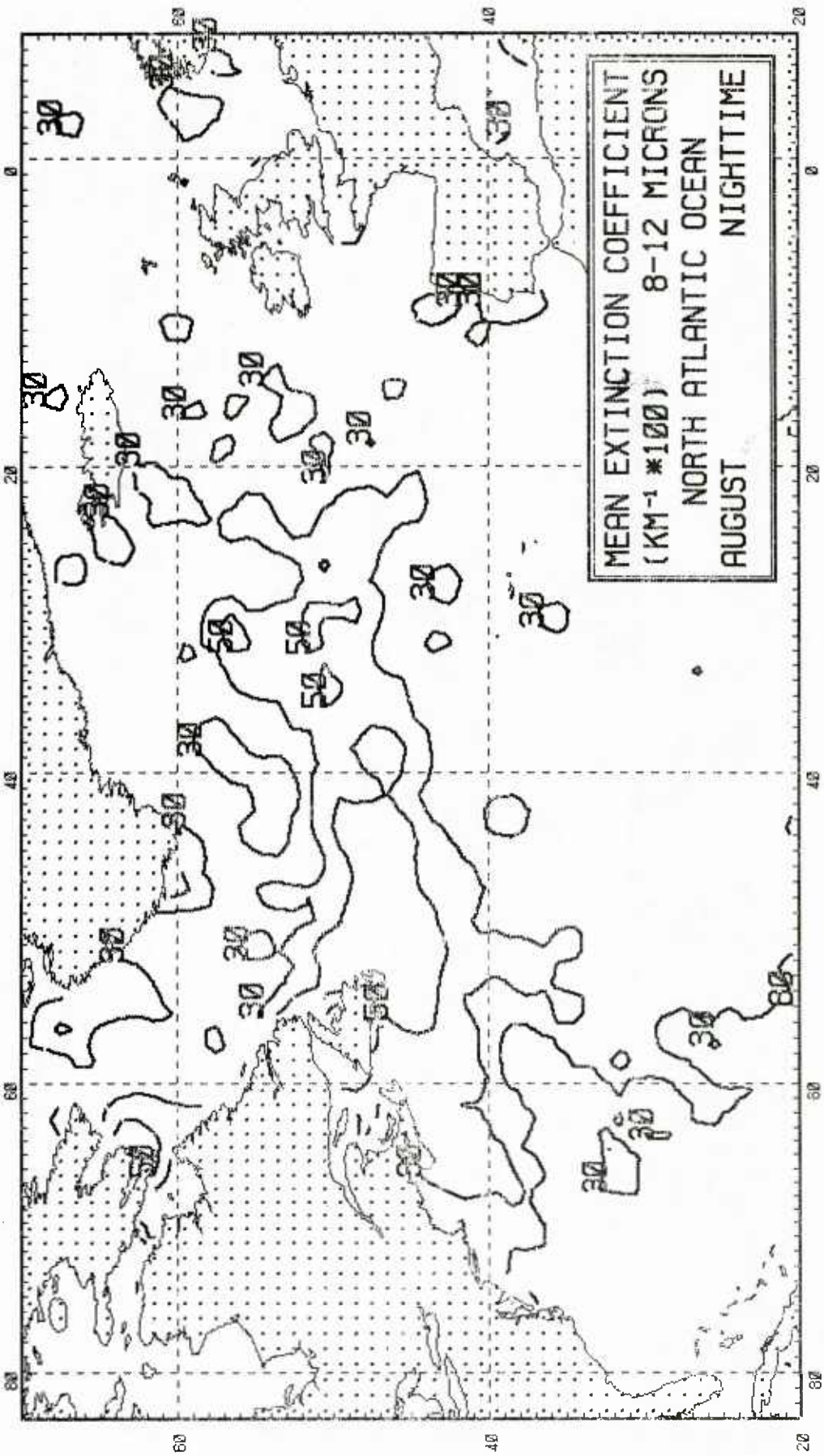
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
8-12 MICRONS
NORTH ATLANTIC OCEAN
AUGUST
NIGHTTIME

FIGURE 56

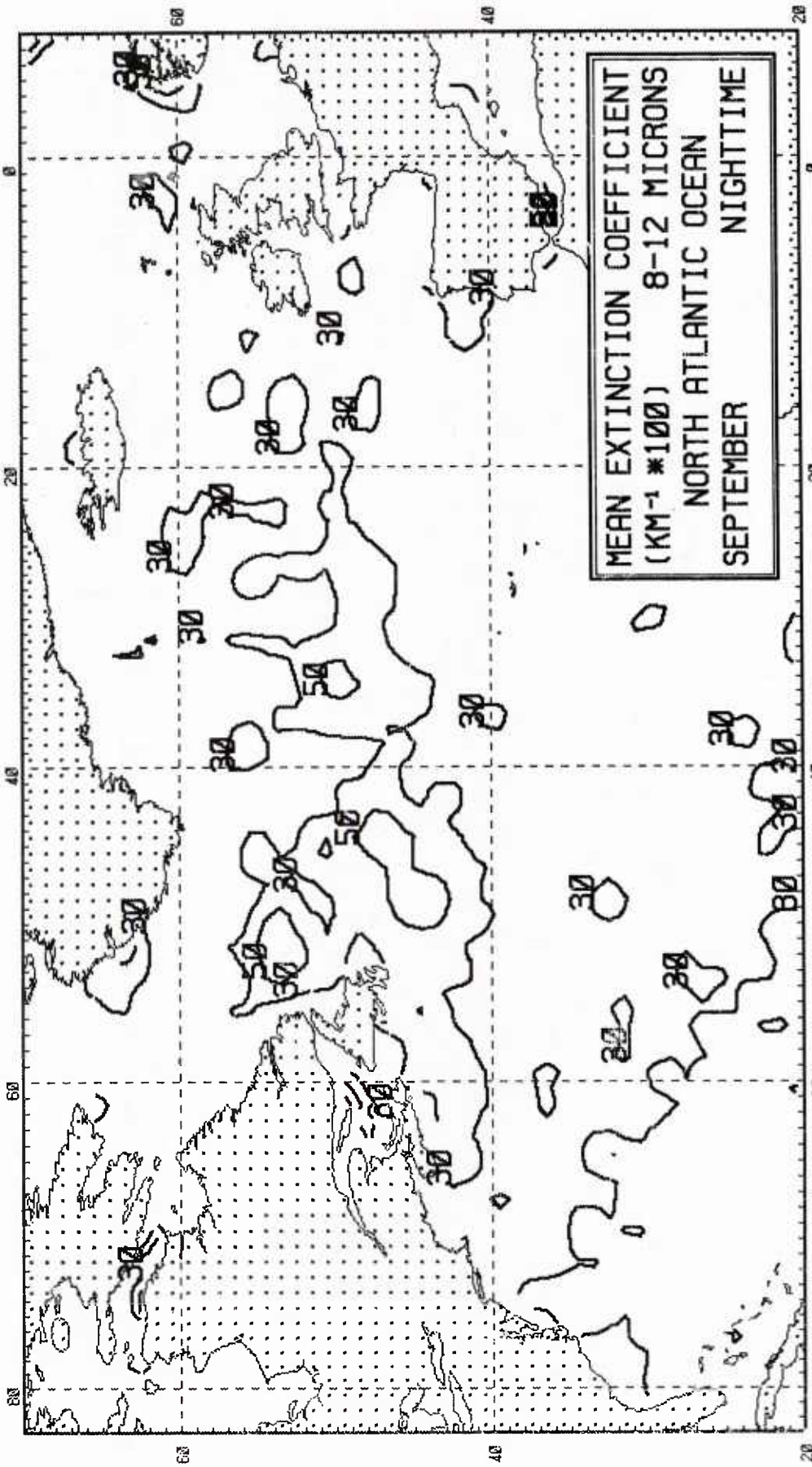
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
SEPTEMBER NIGHTTIME

FIGURE 57

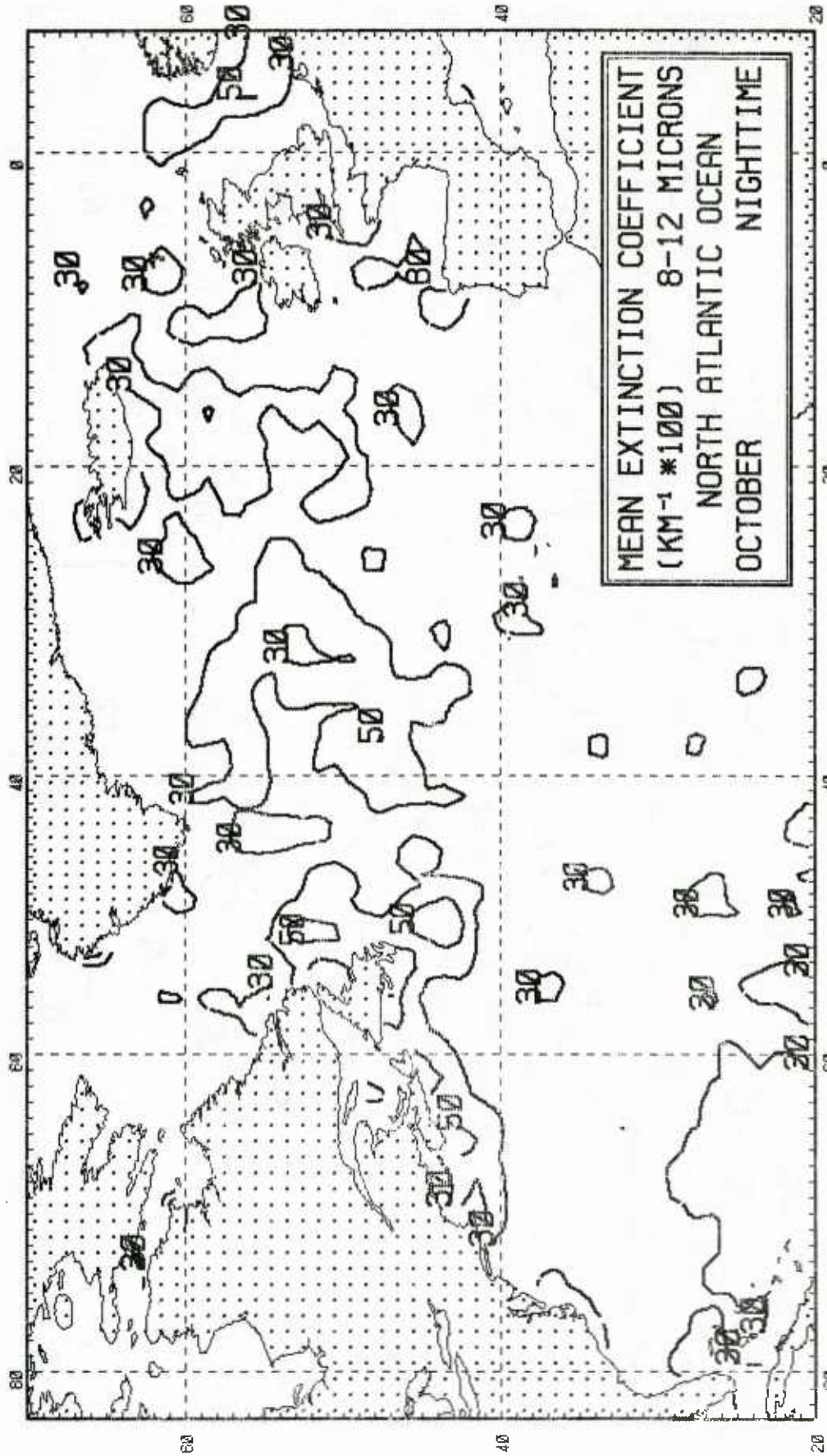
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
OCTOBER NIGHTTIME

FIGURE 58

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
NOVEMBER NIGHTTIME

FIGURE 59

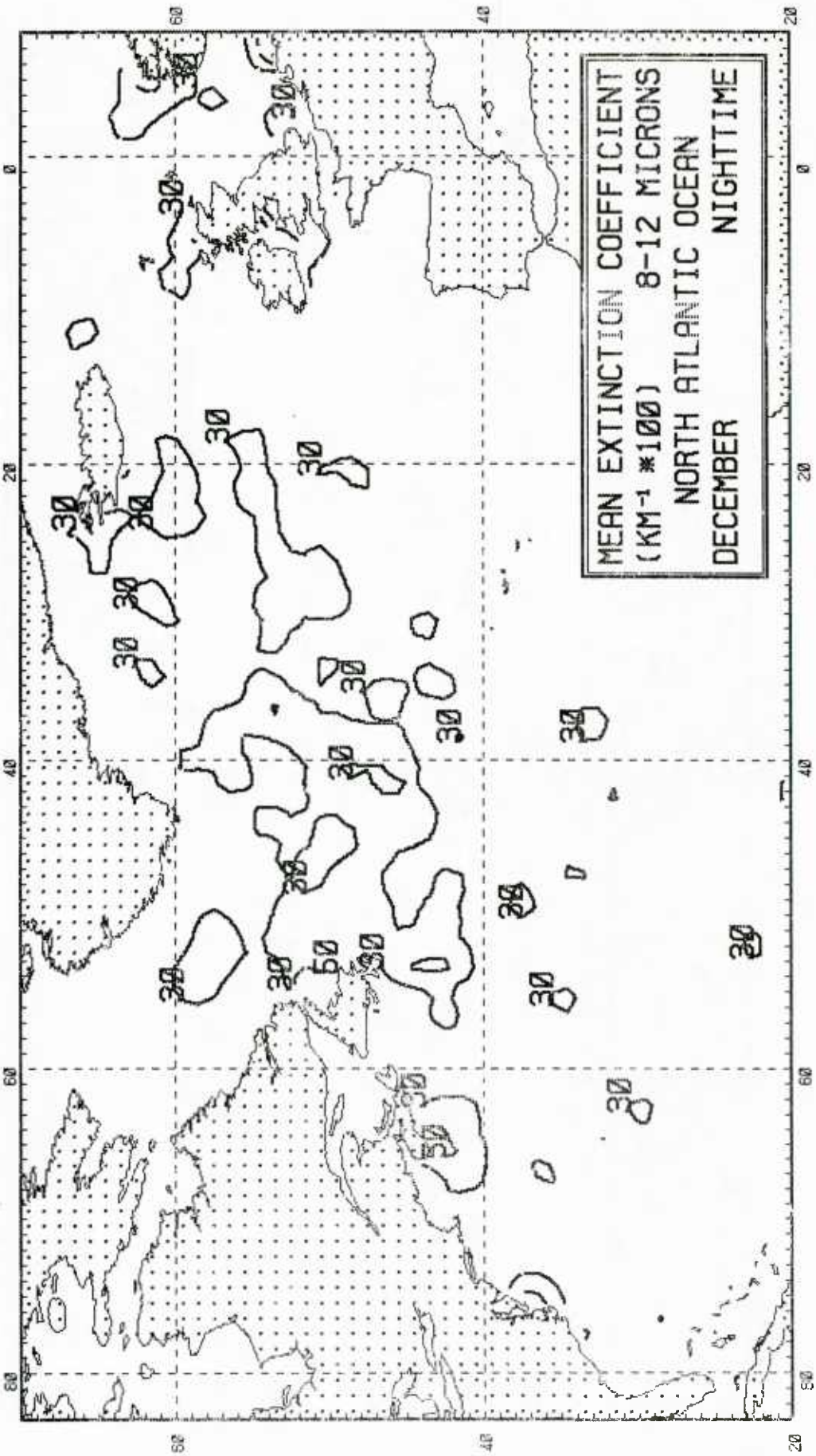
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
DECEMBER NIGHTTIME
60
40
20
0
20
40
60
80
30
50

FIGURE 60

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JANUARY DAYTIME

FIGURE 61

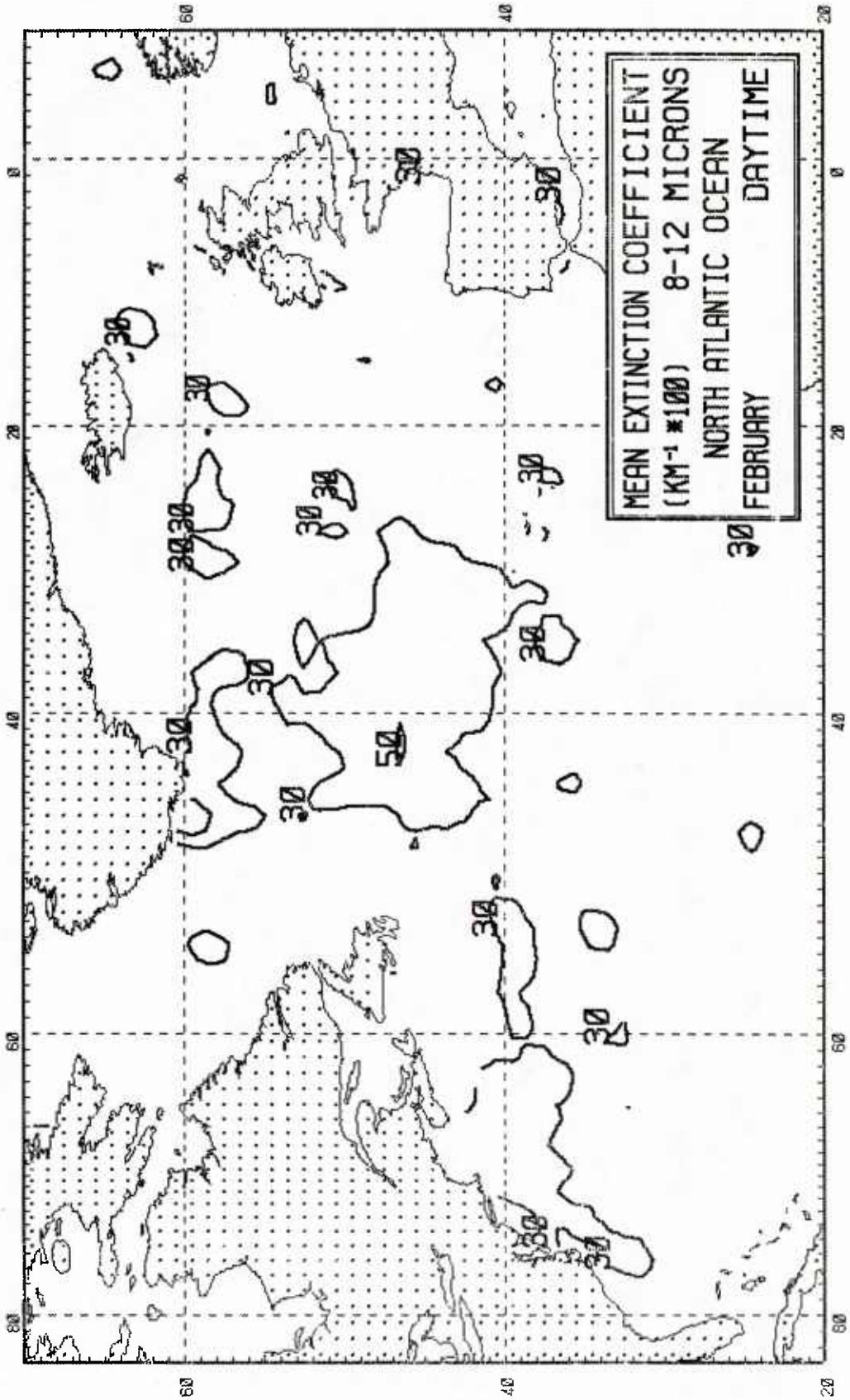
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
FEBRUARY DAYTIME
80
60
40
20
0
30
50

FIGURE 62

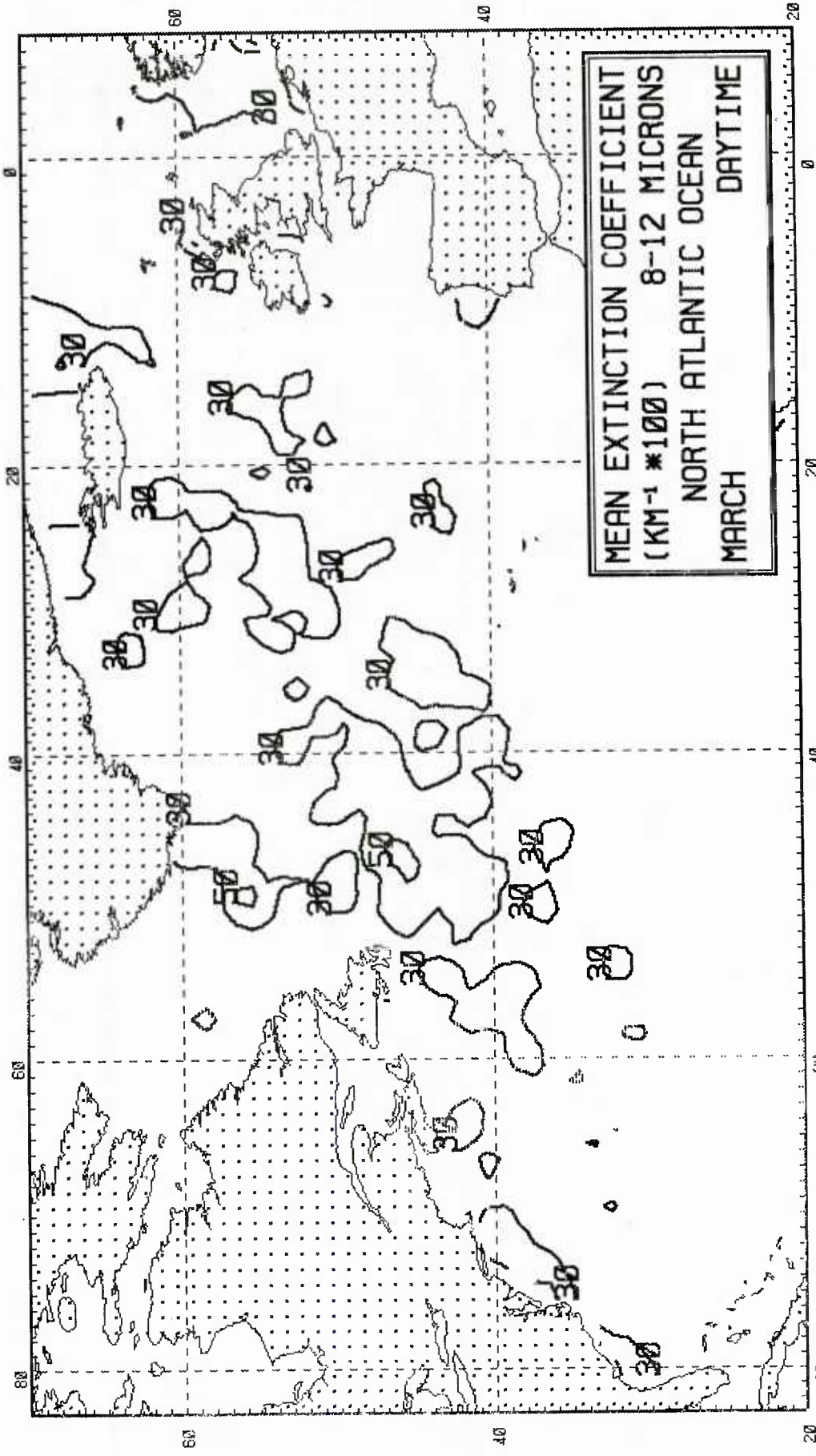
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
MARCH
DAYTIME
80
60
40
20
0
20
40
60
80

FIGURE 63

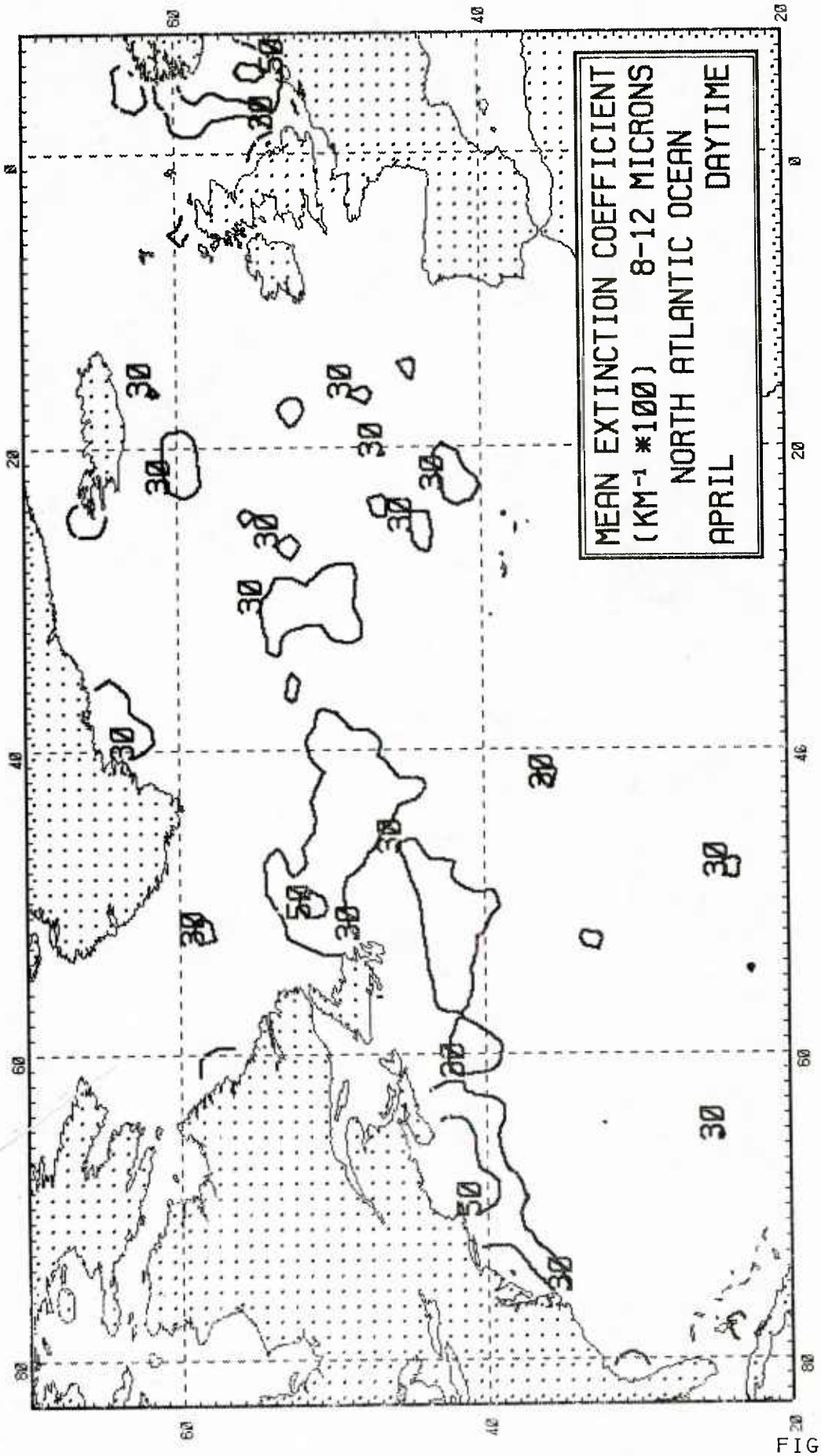
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
APRIL DAYTIME

FIGURE 64

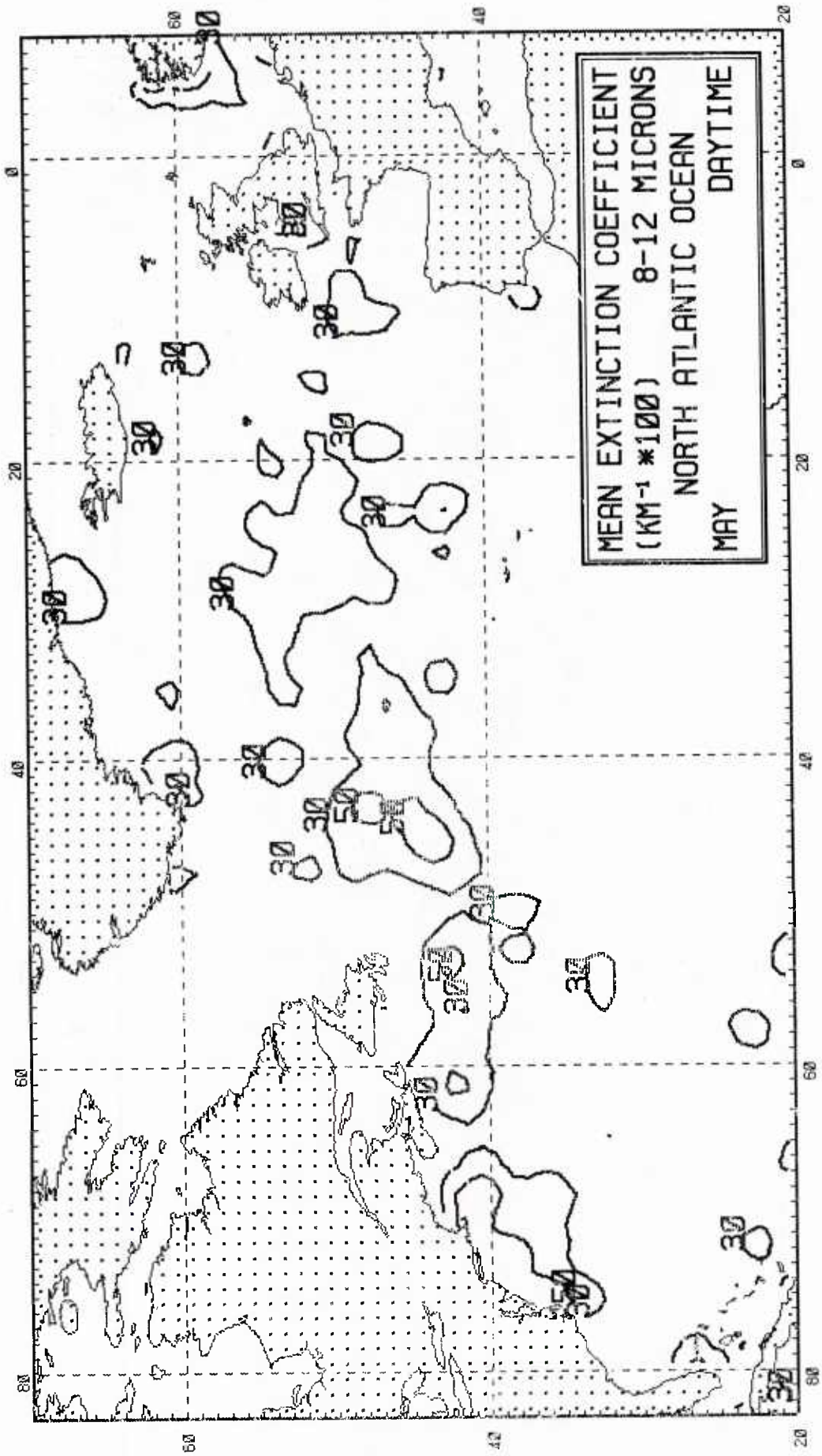
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
MAY
DAYTIME

FIGURE 65

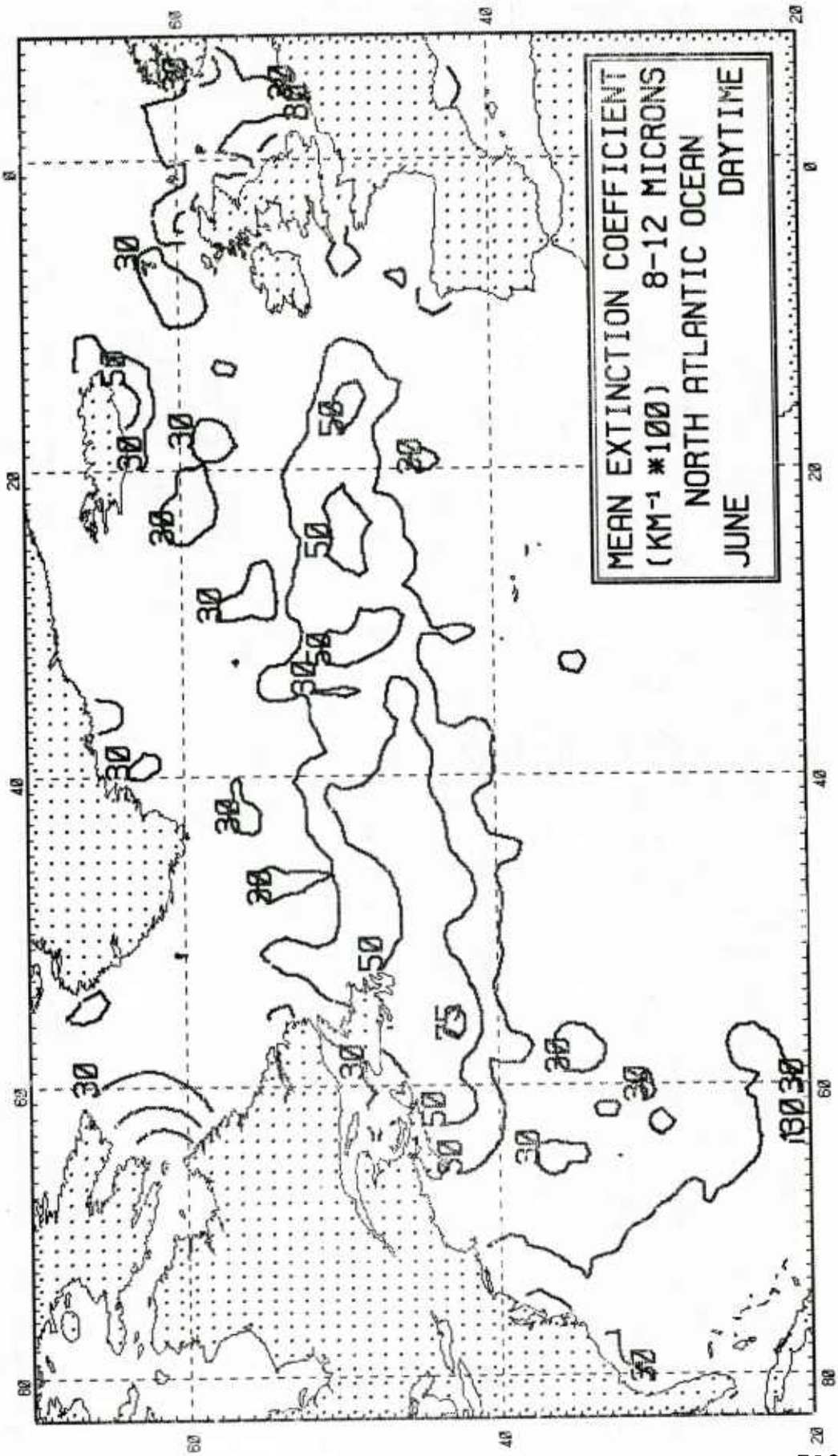
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JUNE DAYTIME

FIGURE 66

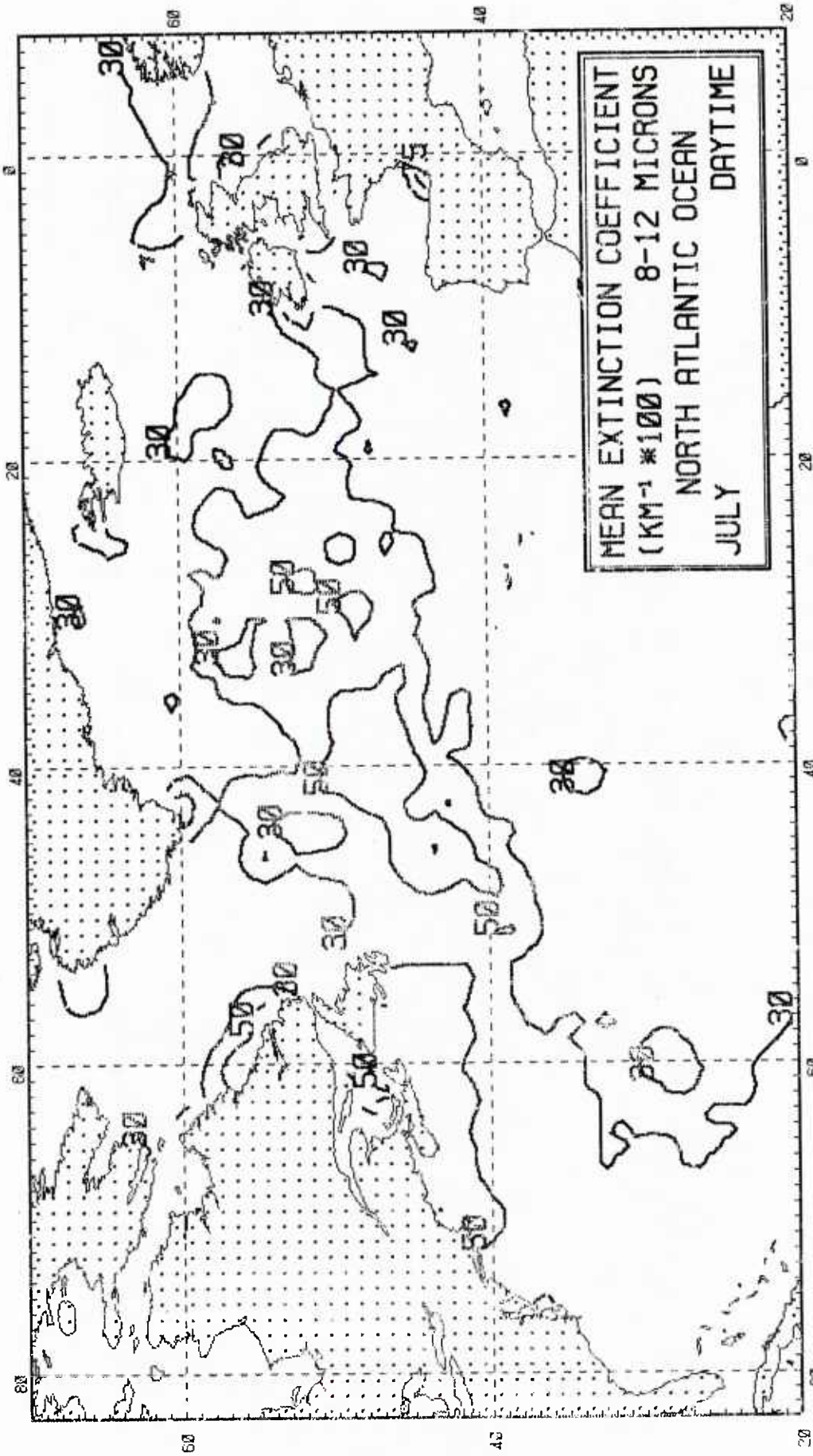
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JULY DAYTIME
80
60
40
20
0
20
40
60
80

FIGURE 67

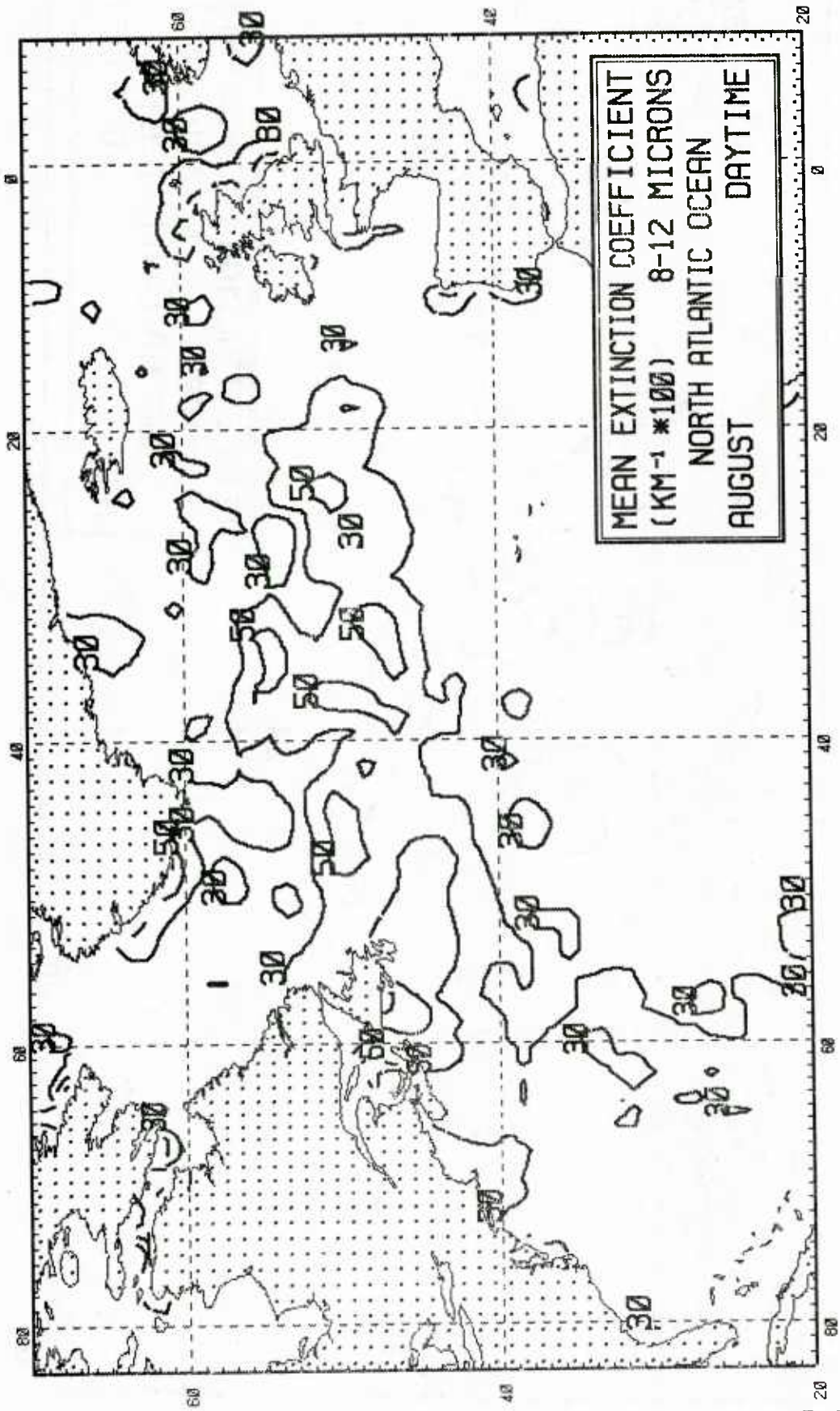
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
AUGUST DAYTIME

FIGURE 68

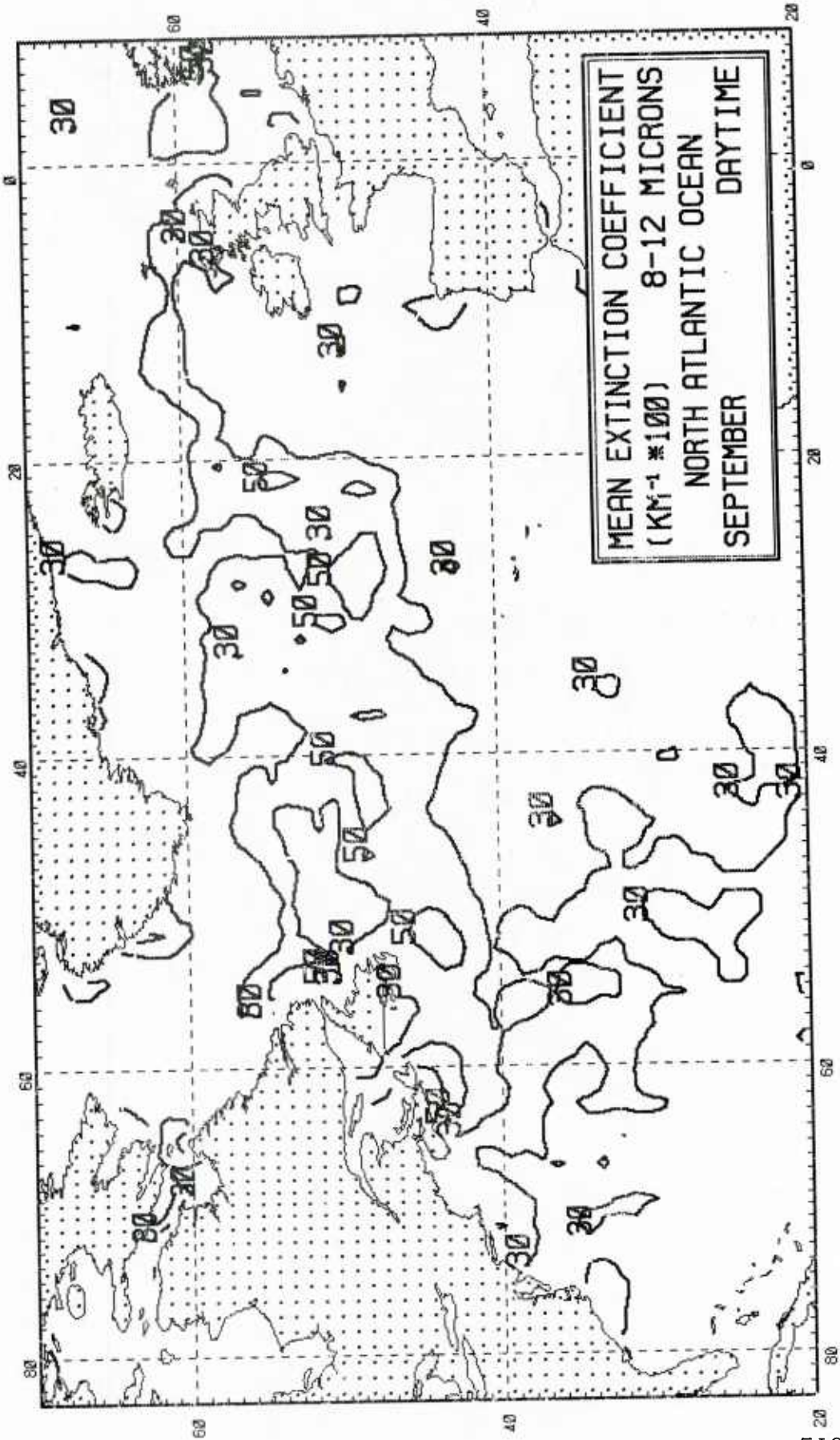
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
8-12 MICRONS
NORTH ATLANTIC OCEAN
SEPTEMBER
DAYTIME

FIGURE 69

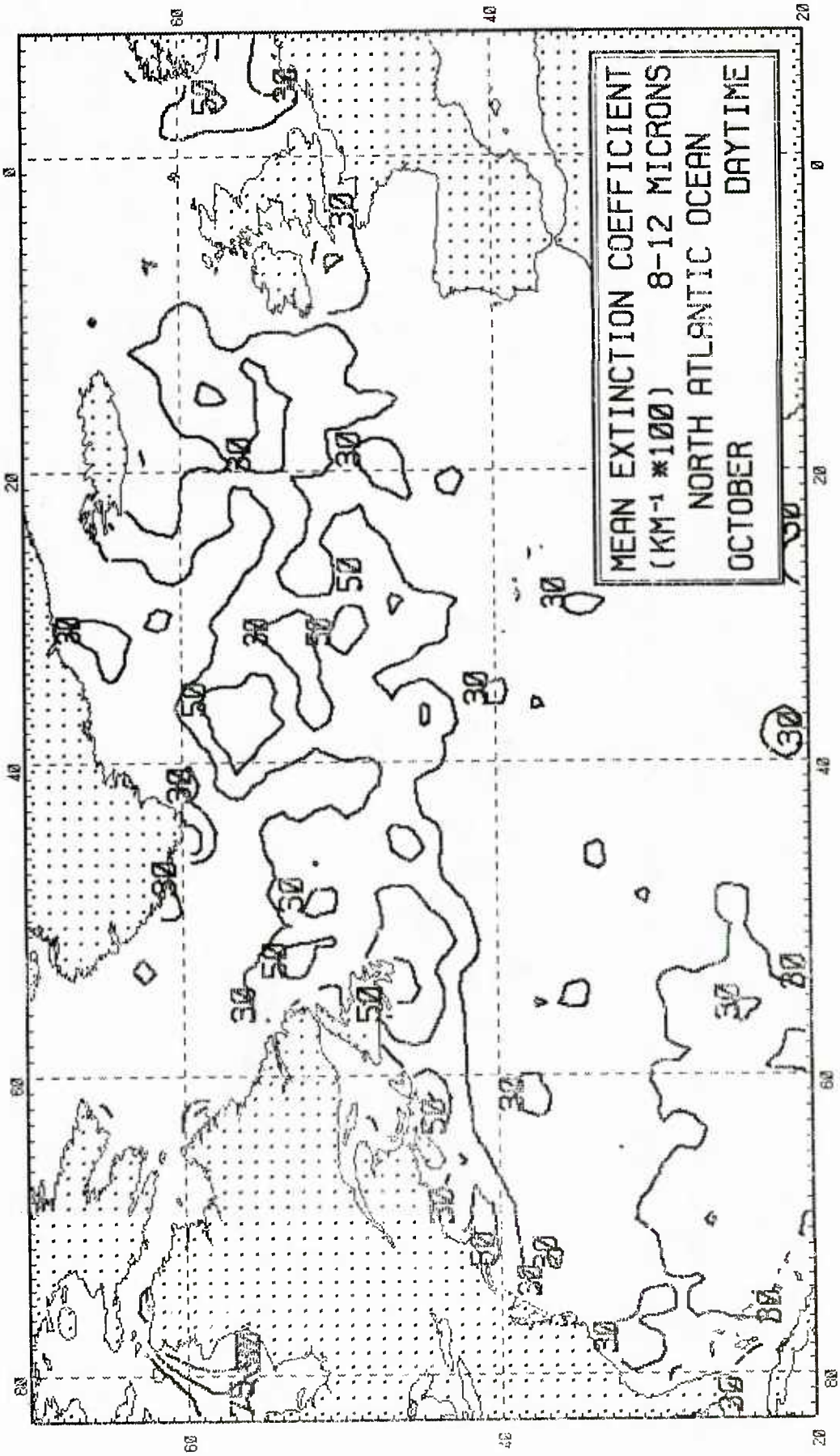
MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100)
8-12 MICRONS
NORTH ATLANTIC OCEAN
OCTOBER
DAYTIME

FIGURE 70

MEAN EXTINCTION COEFFICIENT
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
NOVEMBER DAYTIME

FIGURE 71

MEAN EXTINCTION COEFFICIENT
(KM-1 *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
DECEMBER DAYTIME

FIGURE 72

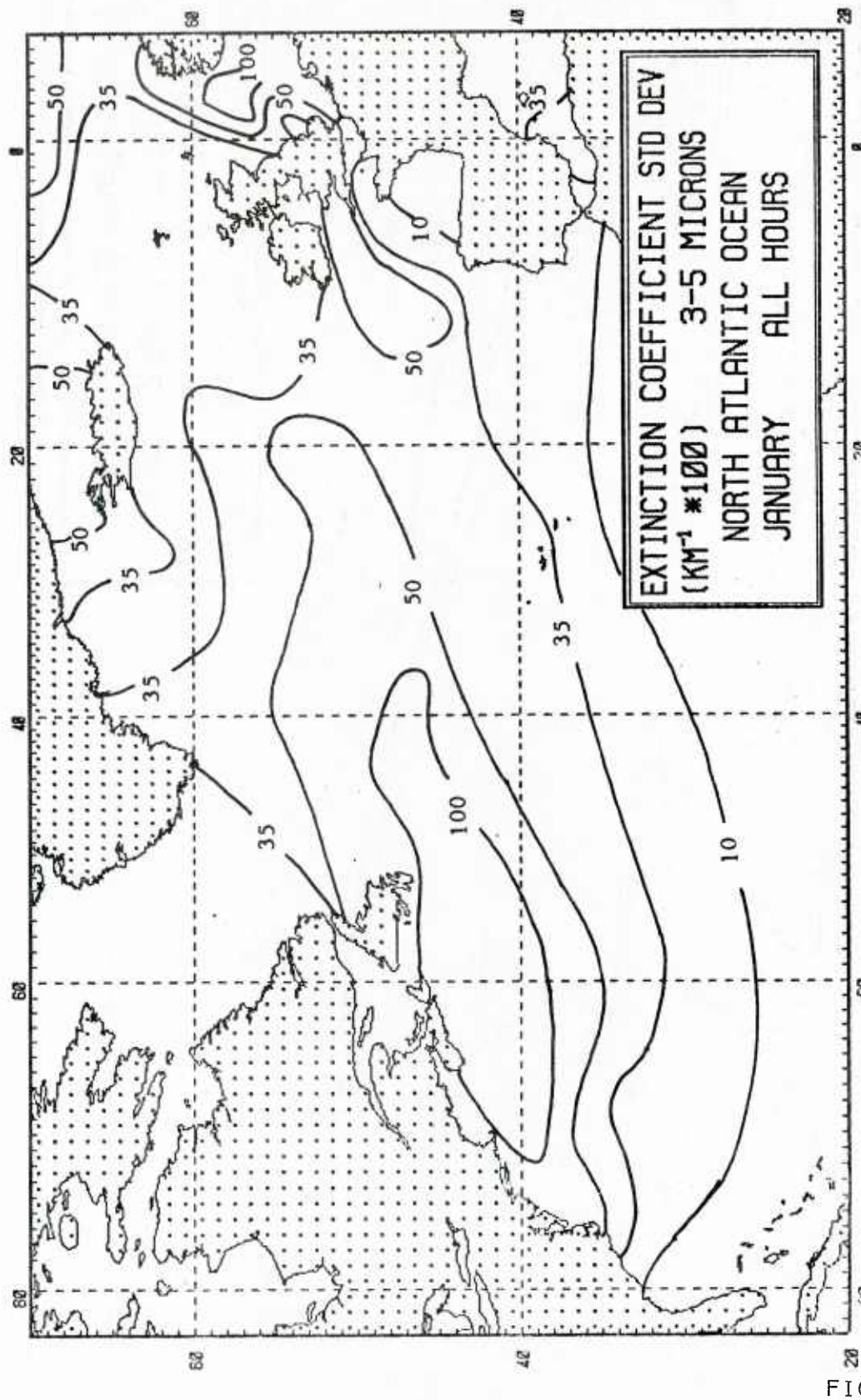
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JANUARY ALL HOURS
100
50
35
10
80
60
40
20
0

FIGURE 73

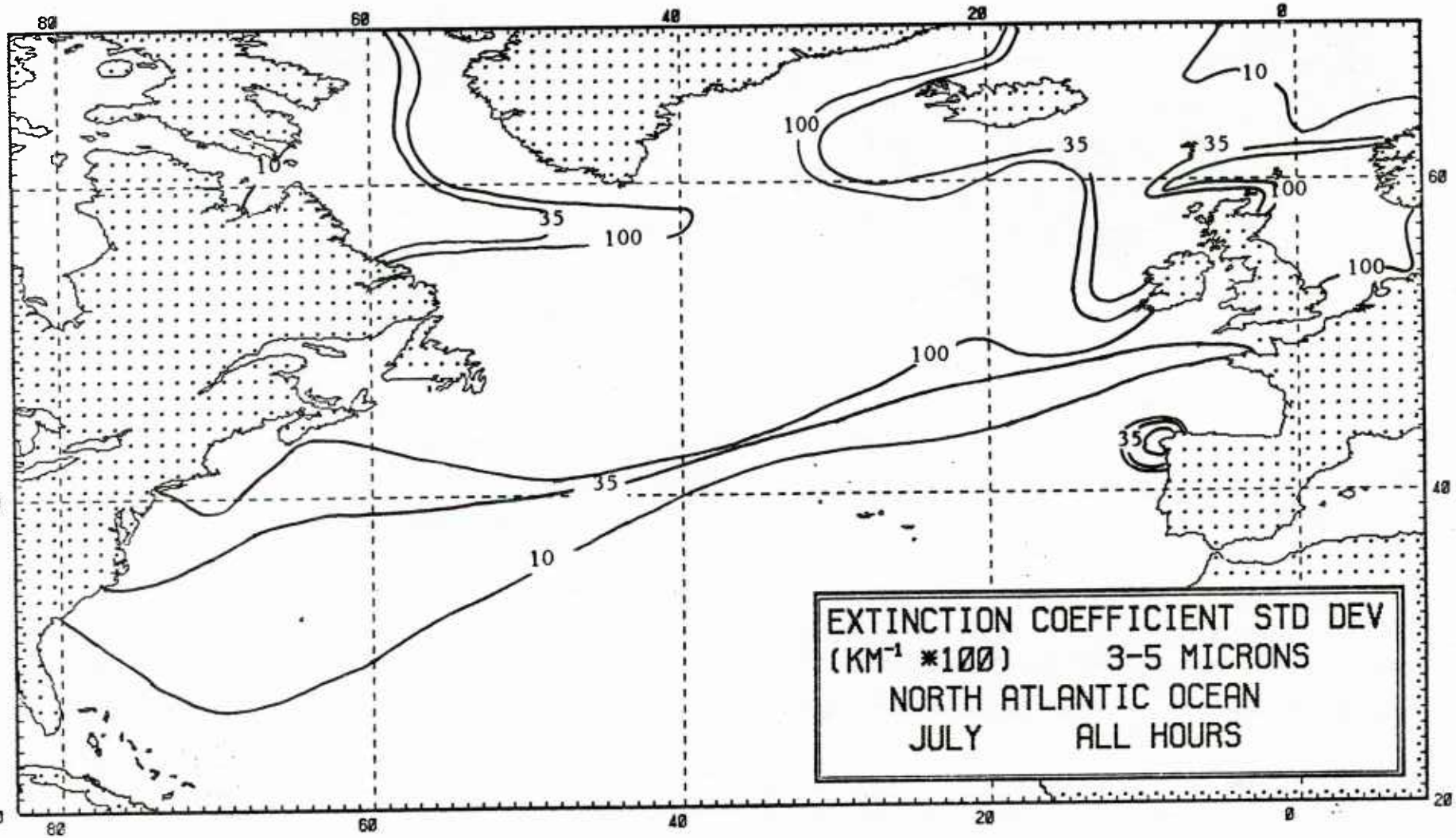
80
60
40
20
0
60
40
20
10
35
100
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JULY ALL HOURS

FIGURE 74

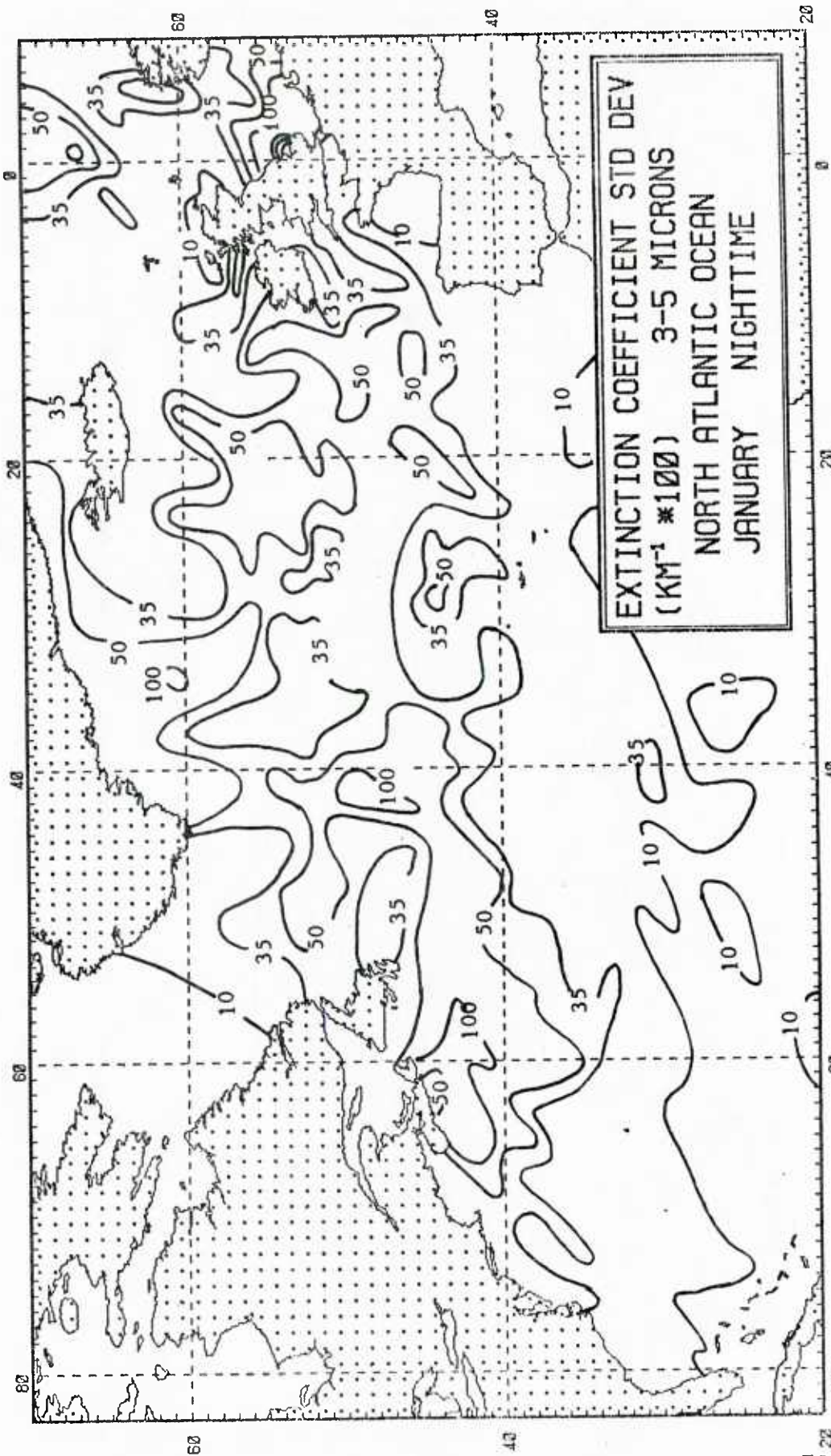
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JANUARY NIGHTTIME

FIGURE 75

EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JULY NIGHTTIME

FIGURE 76

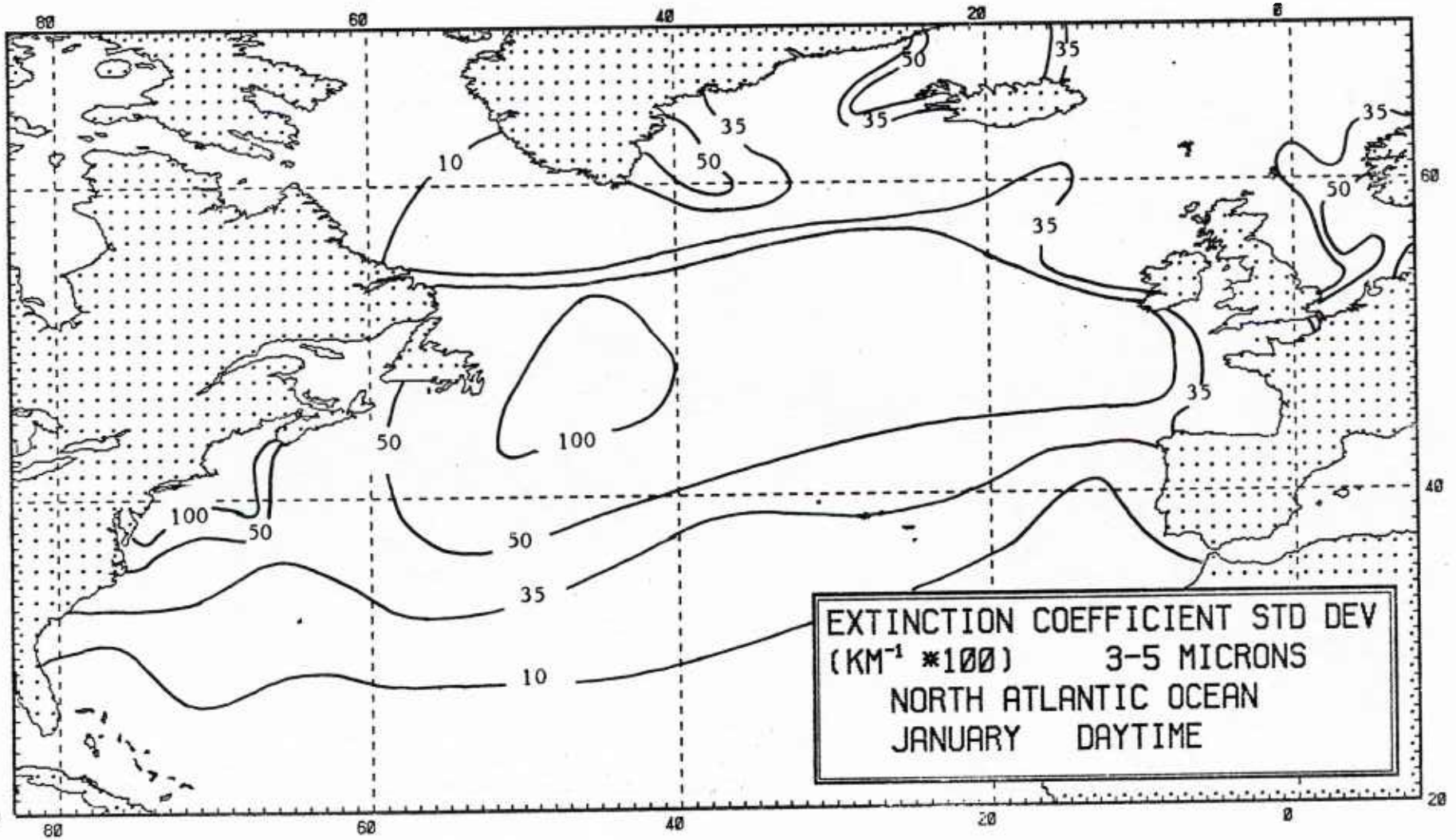
80
60
40
20
0
60
40
20
10
35
50
100
EXTINCTION COEFFICIENT STD DEV
(KM^{-1} *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JANUARY DAYTIME

FIGURE 77

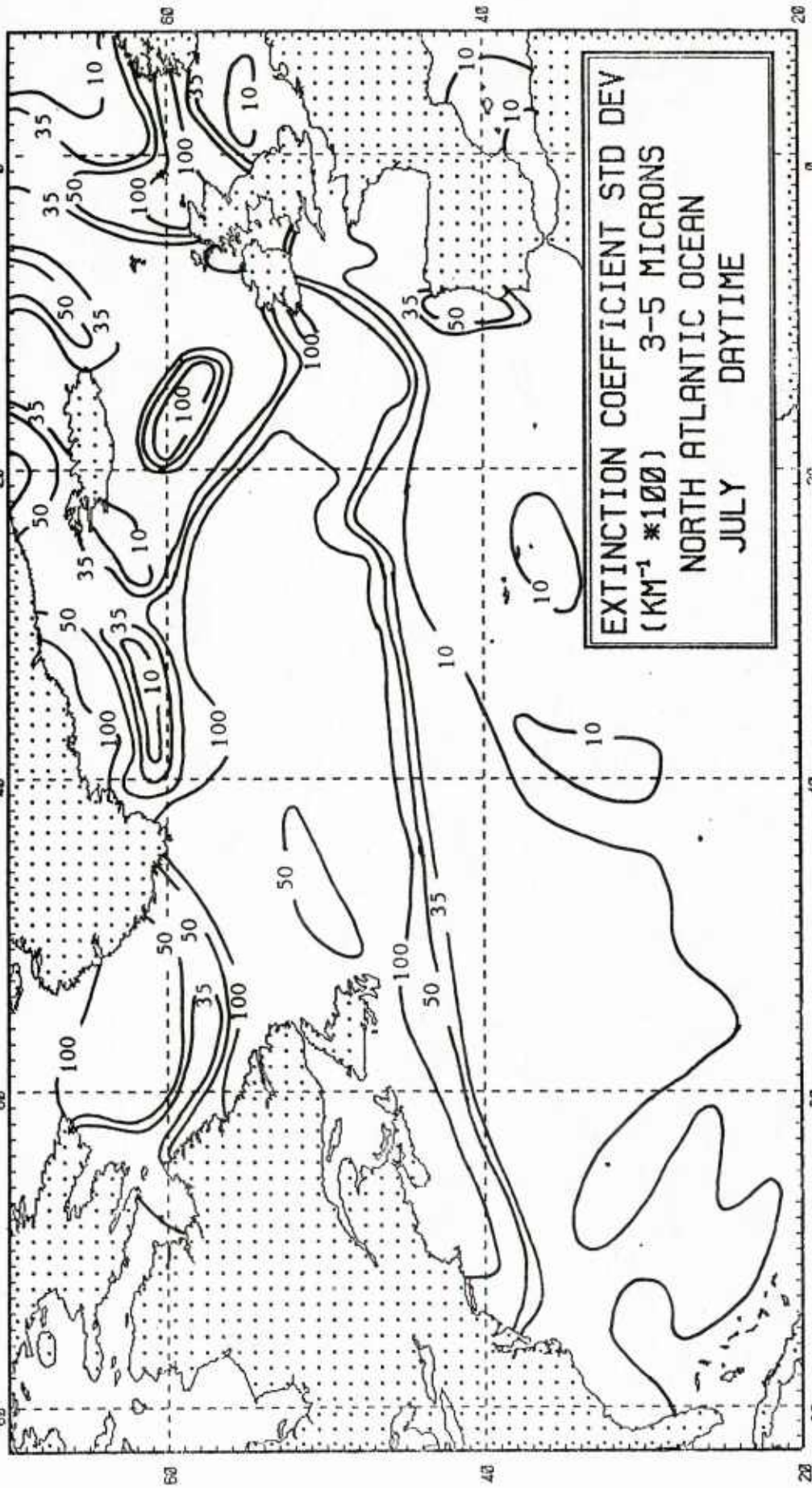
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 3-5 MICRONS
NORTH ATLANTIC OCEAN
JULY DAYTIME

FIGURE 78

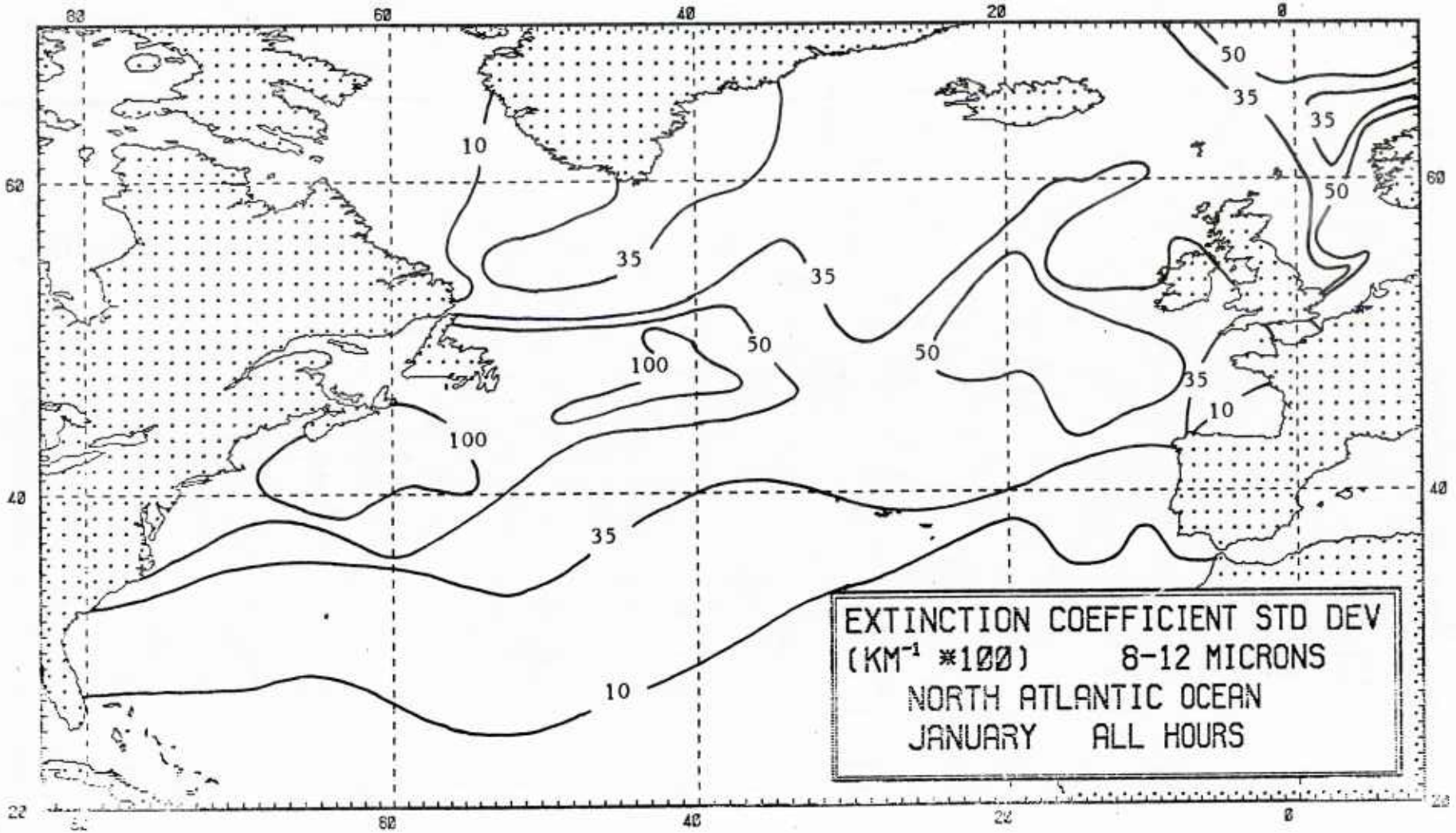
80
60
40
20
0
60
40
20
10
35
50
100
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JANUARY ALL HOURS

FIGURE 79

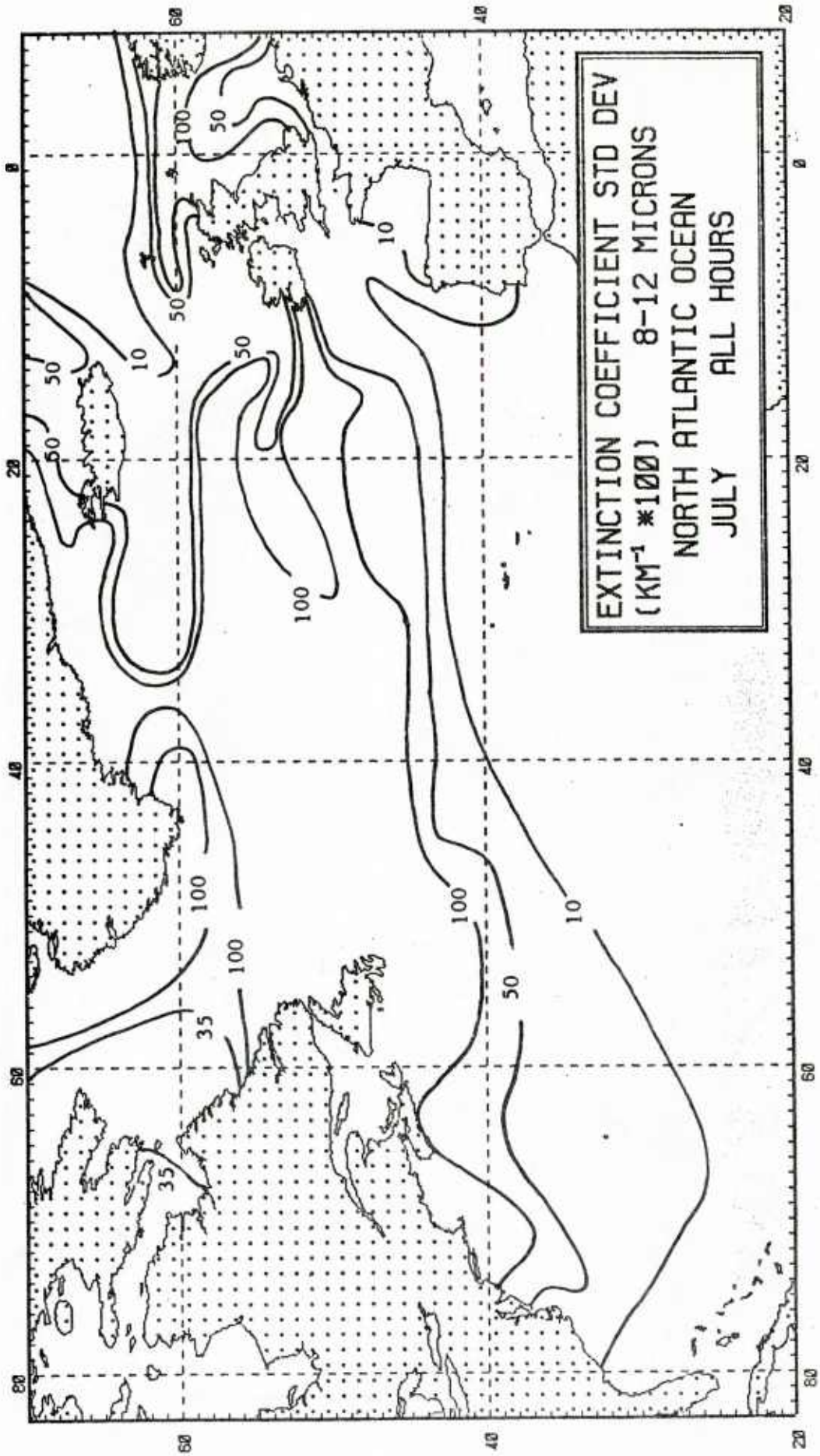
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JULY ALL HOURS
100
50
10
35
60
40
20
0
80

FIGURE 80

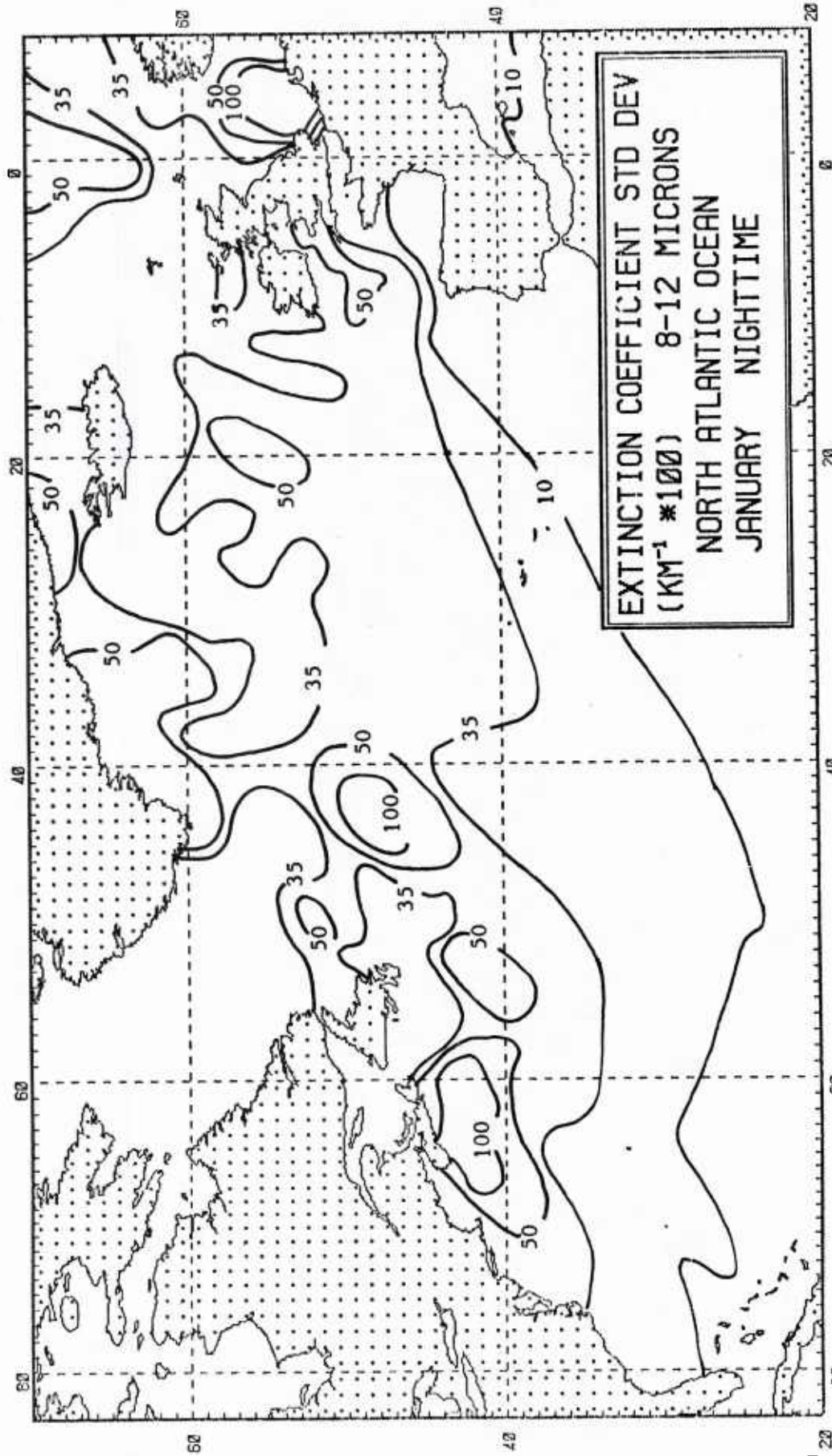
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JANUARY NIGHTTIME
10
35
50
100
60
40
20
0
80

FIGURE 81

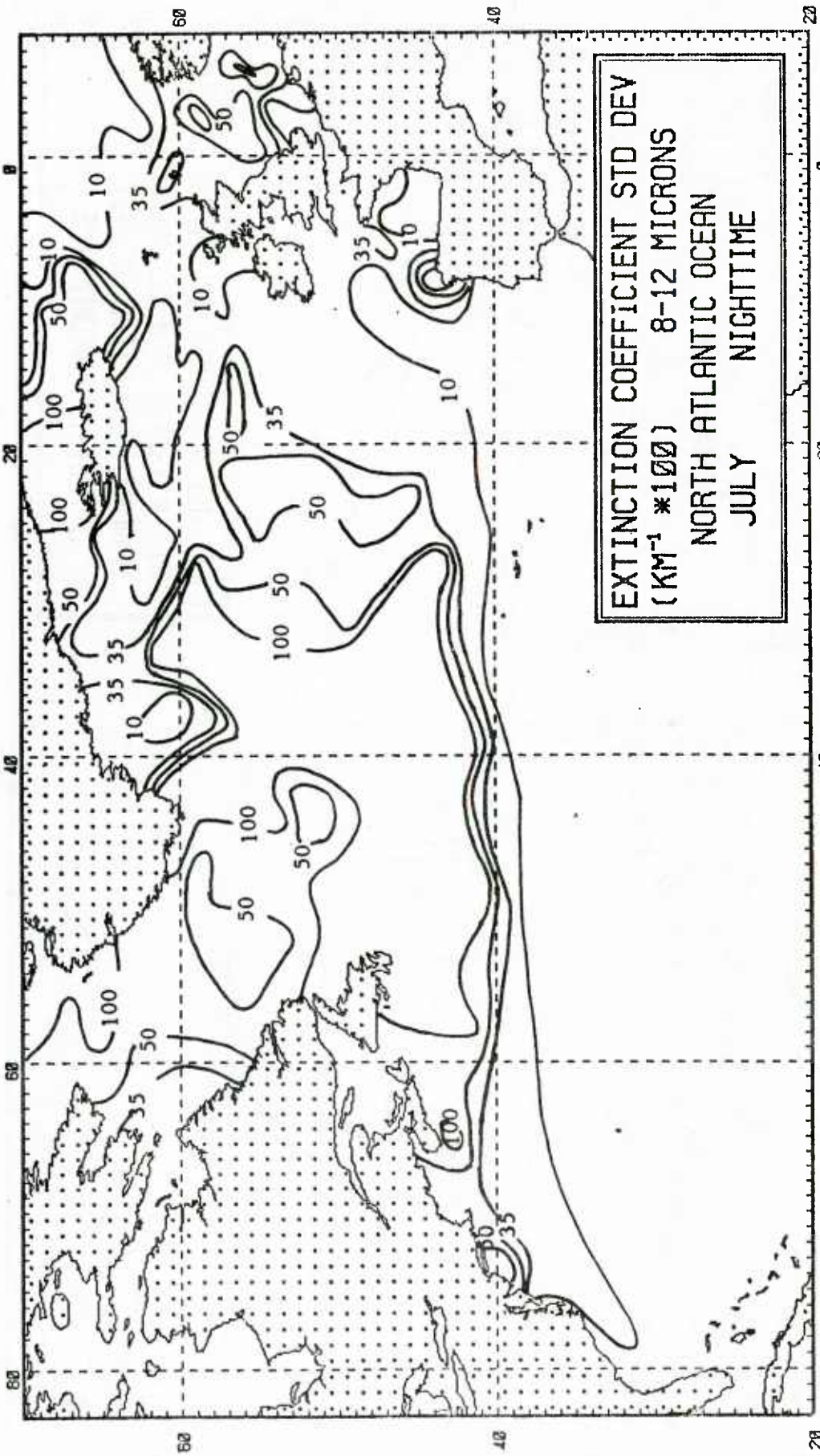
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JULY NIGHTTIME

FIGURE 82

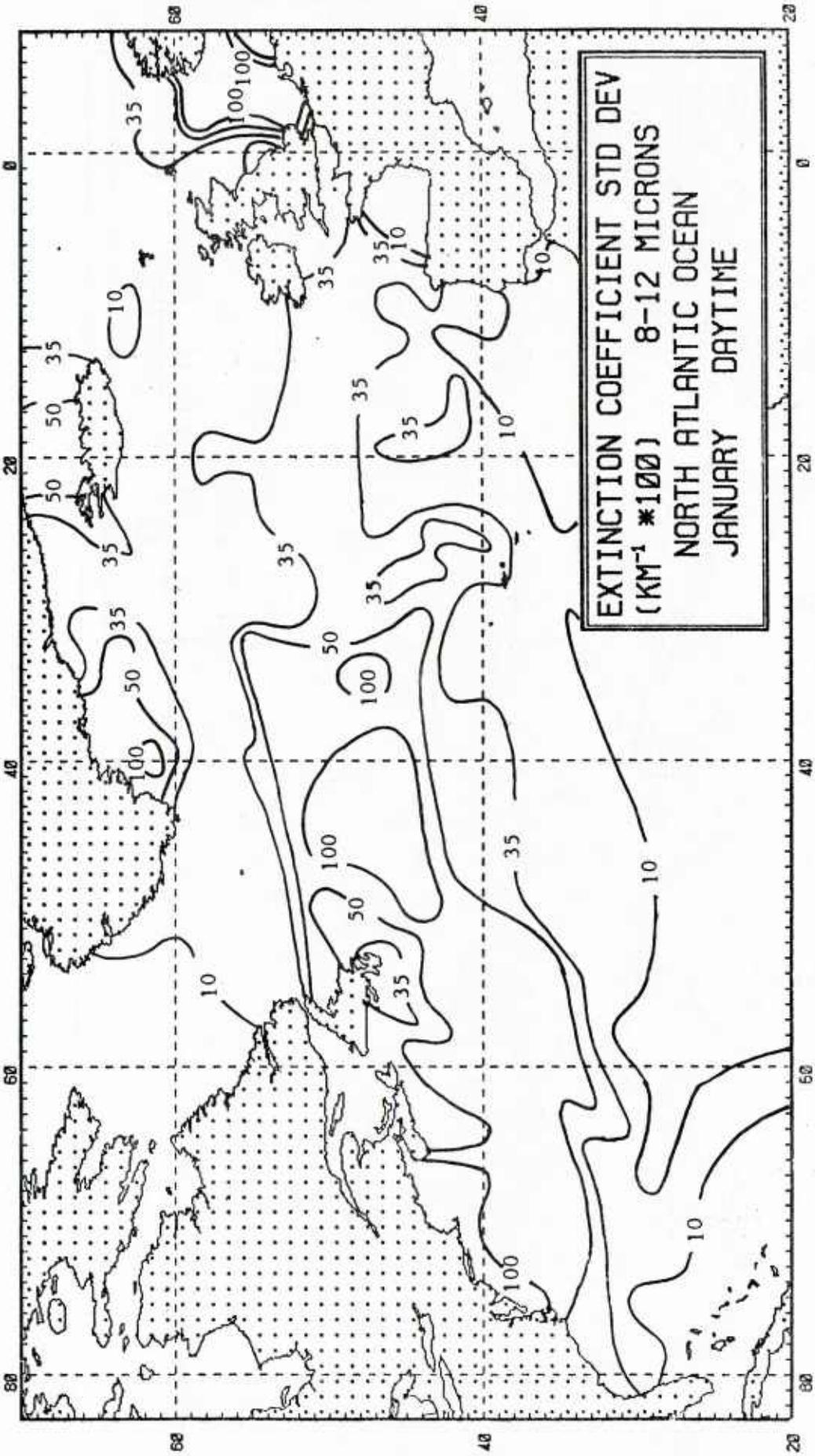
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JANUARY DAYTIME

FIGURE 83

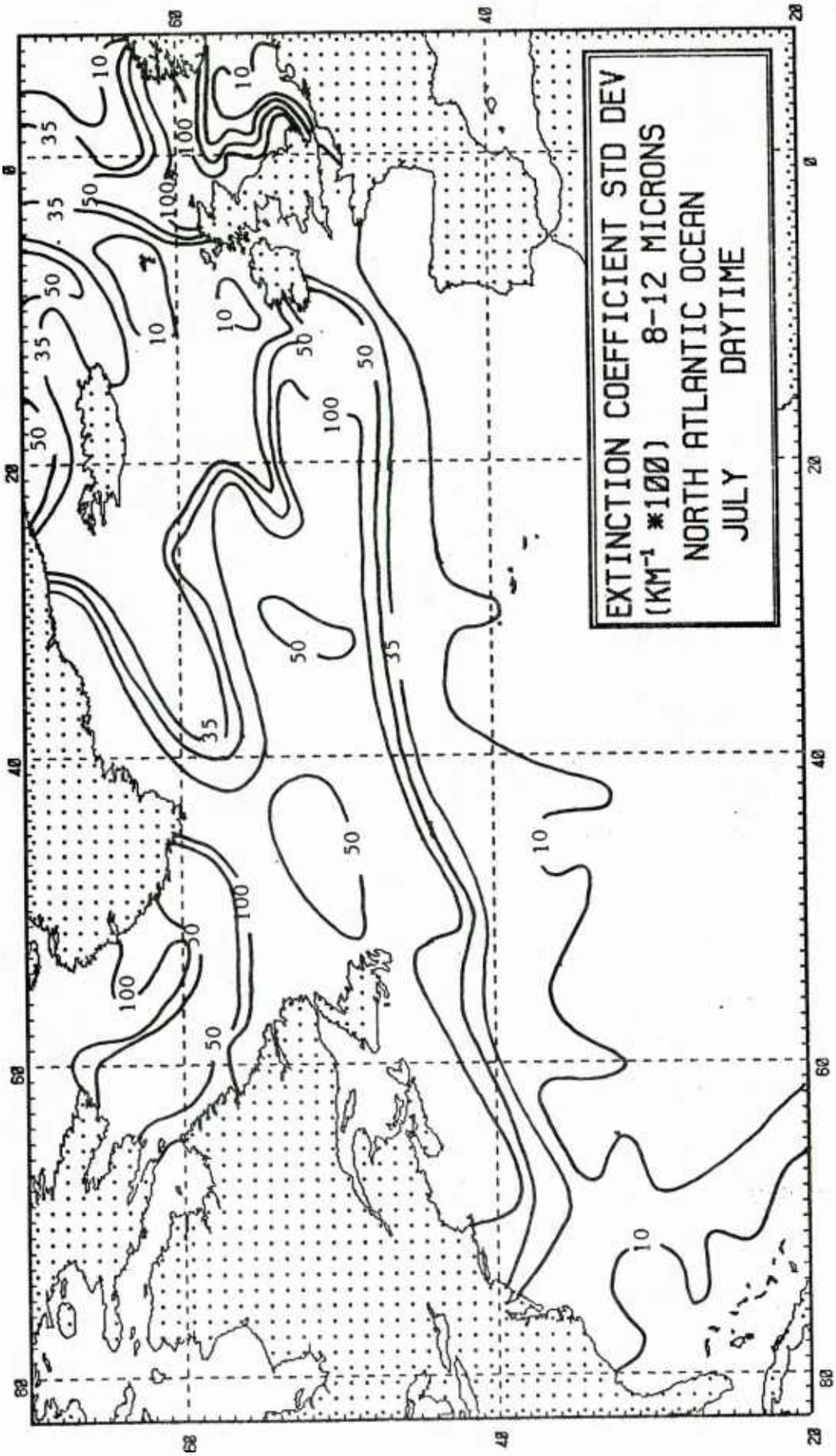
EXTINCTION COEFFICIENT STD DEV
(KM⁻¹ *100) 8-12 MICRONS
NORTH ATLANTIC OCEAN
JULY DAYTIME

FIGURE 84

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